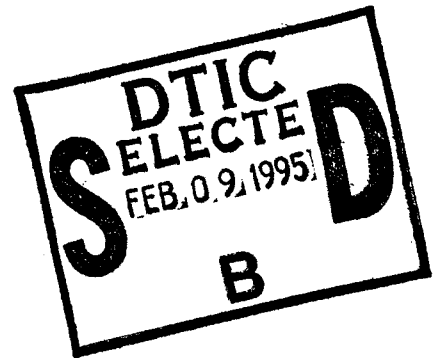PL-TR-94-2242

PASP PLUS TIME HISTORY DATA BASE FILE STRUCTURES

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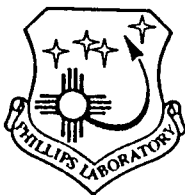
19 September 1994

Scientific Report No. 1

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PHILLIPS LABORATORY
Directorate of Geophysics
AIR FORCE MATERIEL COMMAND
HANSCOM AIR FORCE BASE, MA 01731-3010

"This technical report has been reviewed and is approved for publication"

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Contract Manager
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Data Analysis Division

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13. ABSTRACT (Maximum 200 words)

A Time History Data Base (THDB) is to be developed for the Photovoltaic Array and Space Power Experiment - Plus Diagnostics (PASP+) sensor package flown aboard the APEX satellite. A THDB system has been developed for the generation and display of the THDB data.

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TABLE OF CONTENTS

1.0   OVERVIEW

A Time History Data Base (THDB) for the Photovoltaic Array and
Space Power - Plus Diagnostics (PASP+) sensor package flown
aboard the APEX Spacecraft is to be generated for use in
surveying the sensor data and to provide a structured input for
post-flight analysis. To that end, a software analysis package
has been developed for the generation of the THDB structures. In
addition, a PC hosted graphics package has been developed for
surveying the data.

The data flow from spacecraft through to THDB generation can be
synopsized as follows:

-    Spacecraft data is downlinked to Air Force Satellite Control
     Network (AFSCN) Remote Tracking Stations (RTS) multiple
     times each day.

-    The downlinked data is recorded on instrumentation tape at
     the RTS and the tapes are shipped to PL/GPD for processing.

-    An Orbital Data Processing (ODP) has been developed by
     PL/GPD to decommutate the data, quality check the data, and
     generate agency specific files of time tagged telemetry data
     along with ancillary information such as spacecraft attitude
     and ephemeris. The ODP requirement was to process data and
     generate Agency Files for each day of spacecraft lifetime.
     Thus, each Agency File contains data from approximately
     00:00 UT to 24:00 UT. In order to generate the Agency Files
     for a specific day, all RTS tapes containing data for that
     day must have been received at PL/GPD. The Agency Files are
     generated on the PL/GPD VAX4000 system.

-    Selected Agency Files are the input to the THDB generation
     software. When all required files for a specific day are
     generated, they are networked to the GPS VAX4000 system
     where the THDB generation software is resident.

-    The THDB software and analysis packages perform additional
     quality checks on the data and generate the required THDB
     files.

-    The THDB files are then networked to an optical disk system
     resident on a GPS UNIX system.

-    The PC hosted display package which has been developed for
     use in surveying the PASP+ data can access the data from
     optical disk, CD-ROM, or other media.

1

This document contains the format of all files used as input to the generation of the THDB files as well as the format of all THDB files. The format information is included in Chapter 2. Chapter 3 contains telemetry information which is included as background for the interested user of this document. Appendix A contains a definition of the parameters contained in the Spacecraft State of Health file. A succeeding document will contain detailed information on the PC hosted graphics package.

2.0 PASP+ THDB STRUCTURE

Each THDB file will contain the data for a 24 hour period, unless otherwise specified. Each file:

- is generated in binary integer form using INTEGER*4, INTEGER*2, and BYTE (INTEGER*1) construction. This technique allows direct input into routines hosted on all byte oriented systems. The files will be generated in big-endian architecture (most significant data byte comes first).

- contains time tagged, uncalibrated, structured data sets. By maintaining the data set in uncalibrated form, the pitfall of file regeneration necessitated by post-launch modifications to calibration parameters or techniques is avoided. Internal record structures have been designed for logical input into data analysis routines.

- contains fixed length records throughout the file.

- consists of a header record followed by a series of data records. The header record, will contain file unique information such as date and THDB file ID.

- contains data quality flags.

2.1 EPHEMERIS AGENCY FILE

This file is generated by the Agency Tape (AT) Orbital Data Processing System (ODPS).

All words are 32-bit positive integers (31 data bits and the MSB set equal to 0). Offset and bias values are provided to convert the positive integer values to true units. The ephemeris data will be generated at a rate of once per minute. Each Agency Data Tape (ADT) ephemeris file data record will contain the ephemeris parameters from six (6) one-minute intervals.

2

To convert the 32-bit positive integers into proper units, subtract 2**30 from the value and then multiply by the appropriate factor. All factors are in powers of 10. The table below gives the appropriate multiplicative factor for each word on the ephemeris file (e.g. if power is 2, then multiply the integer word by 10**2 after subtracting 2**30).

HEADER RECORD FORMAT

Word Number	Description
1	Vehicle ID (901)
2	File ID (1)
3	Year (e.g. 1991)
4	Day of Year
5	UT at start of Data (Milliseconds)
6	UT at end of Data (Milliseconds)
7	Number of eclipse periods (n)
8	Start time of 1st penumbra (UT Milliseconds)
9	Start time of 1st umbra (UT Milliseconds)
10	End time of 1st umbra (UT Milliseconds)
11	End time of 1st penumbra (UT Milliseconds)
12	Start time of 2nd penumbra (UT Milliseconds)
13	Start time of 2nd umbra (UT Milliseconds)
14	End time of 2nd umbra (UT Milliseconds)
15	End time of 2nd penumbra (UT Milliseconds)
.	. . .
.	. . .
.	. . .
4n+8	Start time of nth penumbra (UT Milliseconds)
4n+9	Start time of nth umbra (UT Milliseconds)
4n+10	End time of nth umbra (UT Milliseconds)
4n+11	End time of nth penumbra (UT Milliseconds)
4n+12-300	Vacant ("1"s filled)

DATA RECORD FORMAT

Word Number	Description	Factor
1	Julian Date(Days)	0
2	UT (Milliseconds)	0
3	X, Satellite Position, ECI (Km)	-4
4	Y, Satellite Position, ECI (Km)	-4
5	Z, Satellite Position, ECI (Km)	-4
6	Vx, Satellite Velocity, ECI (Km/Sec)	-7
7	Vy, Satellite Velocity, ECI (Km/Sec)	-7
8	Vz, Satellite Velocity, ECI (Km/Sec)	-7
9	Radius, Earth Center to Satellite(Km)	-4
10	Geodetic Altitude (Km)	-4

11	Geocentric Latitude (Deg)	-6
12	Longitude (Deg) (+E)	-6
13	Velocity (Km/Sec)	-7
14	Local Time (Hr)	-7
15	Radius, MAG (EMR)	-7
16	Latitude, MAG (Deg)	-6
17	Longitude, MAG (Deg) (+E)	-6
18	Radius, SM (EMR)	-7
19	Latitude, SM (Deg)	-6
20	Local Time, SM (Hr)	-7
21	B, (nT)	-4
22	Bx, ECI (nT)	-4
23	By, ECI (nT)	-4
24	Bz, ECI (nT)	-4
25	Magnetic Local Time (Hr)	-7
26	Solar Zenith Angle (Deg)	-6
27	Solar Elevation Angle (Deg)	-6
28	Invariant Latitude (Deg)	-6
29	L-Shell (EMR)	-6
30	BMIN (nT)(Model field at Mag Equator)	-4
31	BMIN Latitude (Deg)	-6
32	BMIN Longitude (Deg)	-6
33	BMIN Altitude (Km)	-3
34	BCONJ Latitude (Deg)	-6
35	BCONJ Longitude (Deg)	-6
36	BCONJ Altitude (Km)	-4
37	X Sun Position-ECI (Km)	0
38	Y Sun Position-ECI (Km)	0
39	Z Sun Position-ECI (Km)	0
40	Right Ascension of Greenwich	-6
41	Mx Dipole Moment-ECI (nT)	-4
42	My Dipole Moment-ECI (nT)	-4
43	Mz Dipole Moment-ECI (nT)	-4
44	Dx Dipole Offset-ECI (Km)	-4
45	Dy Dipole Offset-ECI (Km)	-4
46	Dz Dipole Offset-ECI (Km)	-4
47	Rev. Number	1
48-50	Vacant	
51-100	Repeat order of words 1-50 for 2nd minute	
101-150	Repeat order of words 1-50 for 3rd minute	
151-200	Repeat order of words 1-50 for 4th minute	
201-250	Repeat order of words 1-50 for 5th minute	
251-300	Repeat order of words 1-50 for 6th minute	

Notes:

1.   MAG - Magnetic Coordinates: The Z axis is parallel to the
     dipole, and the South geographic pole is in the +X, Z plane.

2.   SM - Solar Magnetic Coordinates: The Z axis is parallel to
     the dipole, and the Sun is in the +X, Z plane.

3. GSM - Geocentric Solar Magnetospheric Coordinates: The X axis is parallel to the earth - Sun line, and the earth's dipole is in the X, +Z plane.

4. EMR = 6371.2 Km

5. The equatorial radius is defined as 6378.135 Km, and the flattening is 298.26.

2.2 ATTITUDE/MAGNETIC FIELD FILE AGENCY FILE

This file is generated by the AT ODPS. It will contain the vehicle attitude and magnetometer data.

The coordinate system used for attitude is as follows:

- Pitch: Relative to the sun; positive above, negative below.
- Yaw: Relative to the sun; positive to the right, negative to the left.
- Roll: The rotation angle about the spacecraft X axis in order to place the spacecraft Y axis in the ecliptic.

The Attitude/Magnetic Field File will contain the vehicle attitude and magnetometer data generated at one-minute intervals. The file will consist of a header record followed by a series of data records. Each data record will contain up to 60 data sets. All words will be in 32-bit positive integer form. Bias and offset values are provided to allow conversion of the integer data to engineering units. Gaps will be present whenever there are telemetry dropouts. The last record of any file may contain "1"s filled frames, since the data sets are unlikely to end on a boundary of 60.

To convert the 32-bit positive integers into proper units, subtract 2**30 from the value and then multiply by the appropriate factor. All factors are in powers of 10. The table below gives the appropriate multiplicative factor for each word on the ephemeris file (e.g. if power is 2, then multiply the integer word by 10**2 after subtracting 2**30).

HEADER RECORD FORMAT

Word
Number   Description

(All words are 32-bit integers)

1	Vehicle ID (901)
2	File ID (2)
3	Year (e.g. 1991)
4	Day of Year
5	UT at start of Data (Milliseconds)

```
     6          UT at end of Data (Milliseconds)
  7-540         Vacant
```

DATA RECORD FORMAT

Word Number	Description	Factor
1	UT (Milliseconds)	
2	Computed Pitch	-6
3	Computed Yaw	-6
4	Computed Roll	-6
5	Measured X-Magnetic Field (nT)	-4
6	Measured Y-Magnetic Field (nT)	-4
7	Measured Z-Magnetic Field (nT)	-4
8	Attitude Source Flag (1= on-board computed; 2= post-flight computed; 0= no data available)	
9	Eclipse Flag (0= full sun with normal operation) (1= full sun during sun re-acquisition) (2= eclipse)	
10-18	Repeat order of words 1-9 for next period	
.	. . .	
.	. . .	
.	. . .	
532-540	Repeat order of words 1-9 for 60th period	

2.3 PASP-PLUS AGENCY FILE

The PASP-Plus agency file will be used as input for the generation of a number of THDB files. The PASP-Plus data is in a major frame format that contains 30 minor frames, each 256 bytes in length. The data rate is one minor frame per second. Minor frames missing within major frames (due to telemetry dropout) will be "1"s filled; missing major frames will not be filled. A Dropout Flag in the data records will be set to "1" if any minor frame has been filled. There will be one major frame placed in each data record, ordered from minor frame 0 to minor frame 29.

HEADER RECORD FORMAT

(All words are 32-bit positive integers)

Word Number	Description
1	Vehicle ID (901)
2	File ID (4)
3	Year (e.g. 1991)
4	Day of Year
5	UT at start of Data (Milliseconds)
6	UT at end of Data (Milliseconds)
7-1950	Vacant

DATA RECORD FORMAT

Byte Number	Description
1-4	UT (Milliseconds) at beginning of the major frame
5-260	PASP-Plus data from minor frame 0
261-516	PASP-Plus data from minor frame 1
.	. . .
.	. . .
.	. . .
7429-7684	PASP-Plus data from minor frame 29
7685	Dropout Flag (Value = 1 if any minor frames within this major frame have been 1's filled)
7686-7800	Vacant

2.4 DOSIMETER AGENCY FILE

The Dosimeter Agency File is used as input to the generation of the Average Dosimeter THDB File.

The Dosimeter data can consist of sensor data (normal mode) or housekeeping data. The data in normal mode is in major frame format. There are 34 bytes per minor frame and 24 minor frames per major frame. The data rate is one minor frame per second. When commanded into housekeeping mode, there are 34 bytes per minor frame, but the data is no longer in major frame format. The first byte of each minor frame contains the minor frame ID in sensor data mode, but will have its MSB set to 1 in housekeeping mode.

In normal mode, data blocks have the data arranged in major frame format structured from minor frame 0 through minor frame 23. In housekeeping mode, each data block will consist of 24 groups of the 34 byte minor frames. No data block will contain data from both modes.

Minor frames missing due to telemetry dropout are 1's filled. There will be no fill if an entire major frame is missing due to dropout. A flag bit will be set within each group of 24 minor frames to indicate when a portion of data has been filled. There will be one group of 24 minor frames stored in each physical record.

The sensor provides measurements of radiation dose and particle flux behind four domes of different thicknesses. Separate measurements of accumulated dose and flux due to electrons and protons are obtained. Behind the four domes lie six solid state detectors (SSDs) which provide the measurements.

DOSIMETER SCIENCE DATA (NORMAL MODE) FILE - HEADER RECORD FORMAT

All words are 32-bit positive integers.

Word Number	Description
1	Vehicle ID (901)
2	File ID (5)
3	Year (e.g. 1991)
4	Day of Year
5	UT at start of Data (Milliseconds)
6	UT at end of Data (Milliseconds)
7-210	Vacant

DOSIMETER NORMAL MODE - DATA RECORD FORMAT

Byte Number	Description
1-4	UT (Milliseconds) at the beginning of Dosimeter Science Minor Frame 0
5-38	Dosimeter Science Data from Minor Frame 0
39-72	Dosimeter Science Data from Minor Frame 1
.	. . .
.	. . .
.	. . .
787-820	Dosimeter Science Data from Minor Frame 23
821	Data Flag (value = 1)
822	Dropout Flag (Value = 1 if any minor frames with in this major frame have been 1's filled)
823-840	Vacant

DOSIMETER HOUSEKEEPING MODE - DATA RECORD FORMAT

Byte Number	Description
1-4	UT (Milliseconds) at the beginning of the 1st Housekeeping minor frame
5-38	1st Dosimeter Housekeeping minor frame
39-72	2nd Dosimeter Housekeeping minor frame
.	. . .
.	. . .
.	. . .
787-820	24th Dosimeter Housekeeping minor frame
821	Data Flag (value = 2)
822	Dropout Flag (Value = 1 if any minor frames within this major frame have been 1's filled)
823-840	Vacant

2.4.1   DOSIMETER MAJOR FRAME STRUCTURE

The Dosimeter major frame consists of 24 minor frames per major frame with 34 bytes per minor frame. The minor frame rate is once per second; thus, the period of the major frame is 24 seconds.

The 34 bytes per minor frame are defined as follows:

Byte No.	Contents	Description
1	FRAME	In science mode, this value is the minor frame counter and runs from 0-23. In housekeeping mode, the Most Significant Bit of this byte will have a value of 1.
2	VHILET COUNT	PSD Very High Energy Deposition Event Counter
3-5	TOTAL COUNT	PSD Total Event Count (greater than or equal to 50keV)
6-8	LOLET COUNT	PSD Processed 50 keV to 1 meV Event Count
9-11	HILETA COUNT	PSD Processed 1 MeV to 3 MeV Event Count
12-14	HILETB COUNT	PSD Processed 3 MeV to 10 MeV Event Count
15-19	LOLET DOSE	PSD 50 keV to 1 MeV dose
20-24	HILET DOSE	PSD 1 MeV to 10 MeV dose
25-26	OVERFLOW	PSD A to D Converter overflow count (greater than or equal to 10 MeV)
27	COMMAND MSB	Last command MSB (Data Byte)
28	COMMAND LSB	Last Command LSB (Command Byte)
29	FAULT FLAGS	Bit 0 = Program Memory Fault Flag Bit 1 = Serial Input Fault Flag Bit 2 = Data Memory Single bit Fault Flag Bit 3 = Data Memory Multiple bit Fault Flag Bit 4 = Anomaly flag Bit 5 = Data Memory EDAC Fault Flag Bit 6 = Watchdog test Fault Flag Bit 7 = Watchdog bite Flag
30	PRGM CHKSUM	Program Checksum; most significant byte
31	PRGM CHKSUM	Program Checksum; least significant byte
32	HOUSEKEEPING	Subcommutated Housekeeping data
33	TLM CHKSUM MSB	Checksum, most significant byte
34	TLM CHKSUM LSB	Checksum. least significant byte

Note:

Each of the two thinnest domes (dome 1 and dome 2) has two SSDs.
The six SSDs are referred to as D1A and D1B (from dome 1), D2A
and D2B (from dome 2), D3, and D4. The outputs from each dome
were accumulated six seconds before being placed into the
telemetry stream. The data sets from the various domes are
placed into the telemetry stream as a function of minor frame ID
as follows:

Minor Frames	Dome
0, 6, 12, 18	D1A
1, 7, 13, 19	D1B
2, 8, 14, 20	D2A
3, 9, 15, 21	D2B
4, 10, 16, 22	D3
5, 11, 17, 23	D4

Dosimeter Subcommutated data:

Minor Frame	Description	
0	D1A Detector Bias Voltage	
1	D1B Detector Bias Voltage	
2	D2A Detector Bias Voltage	
3	D2B Detector Bias Voltage	
4	D3 Detector Bias Voltage	
5	D4 Detector Bias Voltage	
6	D1A Reference Voltage Monitor	
7	D1B Reference Voltage Monitor	
8	D2A Reference Voltage Monitor	
9	D2B Reference Voltage Monitor	
10	D3 Reference Voltage Monitor	
11	D4 Reference Voltage Monitor	
12	+ 12V Monitor	
13	+ 8V Monitor	
14	+ 6V Monitor	
15	+ 5V Monitor	
16	+ 5V Reference Monitor	
17	- 6V Monitor	
18	Regulated + 8V Monitor	
19	Detector Temp monitor	
20	Electronics Temp Monitor	
21	Bits 0-3	Watchdog count
	Bits 4-7	Program memory fault count
22	Bits 0-3	Data memory single bit fault count
	Bits 4-7	Data memory multiple fault count
23	Bit 0	Data EDAC Memory enable (active low)
	Bit 1	Data EDAC enable flag
	Bit 2	Program memory ID, 0=PROM; 1=RAM
	Bit 3	Spare
	Bit 4	PROM power on flag
	Bits 5-7	Spare

Note:

Dosimeter Housekeeping Telemetry Packet:

Byte Number	Description
1	Frame ID (MSB = 1 identifies housekeeping packet)
2	D1A Detector Bias Voltage
3	D1B Detector Bias Voltage
4	D2A Detector Bias Voltage
5	D2B Detector Bias Voltage
6	D3 Detector Bias Voltage
7	D4 Detector Bias Voltage
8	D1A Reference Voltage Monitor
9	D1B Reference Voltage Monitor
10	D2A Reference Voltage Monitor
11	D2B Reference Voltage Monitor
12	D3 Reference Voltage Monitor
13	D4 Reference Voltage Monitor
14	+ 12V Monitor
15	+ 8V Monitor
16	+ 6V Monitor
17	+ 5V Monitor
18	+ 5V Reference Monitor
19	- 6V Monitor
20	Regulated + 8V Monitor
21	Detector Temp monitor
22	Electronics Temp Monitor
23	Bits 0-3 Watchdog count
	Bits 4-7 Program memory fault count
24	Bits 0-3 Data memory single bit fault count
	Bits 4-7 Data memory multiple fault count
25	Bit 0 Data EDAC Memory enable (active low) (0=enable; 1=disable)
	Bit 1 Data EDAC enable (0= disabled; 1=enable)
	Bit 2 Program memory ID, 0=PROM; 1=RAM
	Bit 3 Spare
	Bit 4 PROM power on flag
	Bits 5-7 Spare
26	Last command MSB (Data Byte)
27	Last Command LSB (Command Byte)
28	Bit 0 = Program Memory Fault Flag
	Bit 1 = Serial Input Fault Flag
	Bit 2 = Data Memory Single bit Fault Flag
	Bit 3 = Data Memory Multiple bit Fault Flag
	Bit 4 = Anomaly Fault Flag
	Bit 5 = Data Memory EDAC Fault Flag
	Bit 6 = Watchdog test Fault Flag
	Bit 7 = Watchdog bite Flag
29	First Program Memory Error Least Significant address bits.
30	Bits 0-4 First Program Memory Error Most Significant address bits.
	Bits 5-7 Number of program memory errors detected

31	First Data Memory Error Least Significant address bits.
32	Bits 0-4 First Data Memory Error Most Significant address bits.
	Bits 5-7 Number of data memory errors detected
33	TLM CHKSUM MSB Checksum, most significant byte
34	TLM CHKSUM LSB Checksum, least significant byte

2.5 SPACECRAFT STATE OF HEALTH THDB FILE

This is generated by the AT ODPS and contains the spacecraft state of health data. It consists of 1000 bytes polled once per minute. In the Agency Tape generation process, the first 6 bytes are stripped off and the 4-byte spacecraft time is converted to Universal Time in milliseconds. Each data record consists of 14 groups of UT in milliseconds followed by the 990 telemetry bytes. The 4-byte Vehicle Time words have been added following the data in the event that clock correlation is required.

HEADER RECORD

Word No.	Description
1	Vehicle ID (901)
2	Data ID (Stored SOH ID is 11)
3	Year (e.g. 1991)
4	Day of Year
5	UT at start of Data (milliseconds)
6	UT at end of Data (Milliseconds)
7-3510	Vacant

DATA RECORDS:

Byte No.	Description
001-004	UT (milliseconds of day) from minor frame 2
005-994	Telemetry words 11-1000 from spacecraft state of health frame (990 words)
995-1988	Repeat information in bytes 1-994 for next telemetry frame
. . .	. . . .
12923-13916	Repeat information in bytes 1-994 for 14th telemetry frame
13917-13972	4 byte Vehicle Time for each of the 14 SOH frames
13973-14040	Vacant

Note:

1. See Appendix A for full list of telemetry words.

2. The PASP+ temperature data is stored in the following word
   locations:
   Dosimeter Box Temperature   Byte 444
   PASP+ Box Temperature   Byte 447
   PASP+ Shelf Temperature   Byte 448
   PASP+ Panel Temperature   Byte 449
   E-Field Sensor Temperature #1   Byte 450
   E-Field Sensor Temperature #2   Byte 453

2.6   HOUSEKEEPING/SUN SENSOR/CONTAMINATION FILE

The file will consist of time tagged subcommutated housekeeping
data, PASP+ sun sensor data, data from the 2 QCMs (both frequency
and temperature). Although the PASP+ sun sensor reads out twice
per second (AXIS A/AXIS B, AXIS A/AXIS B) only the first of the 2
pairs will be included in this file. The 2 QCMs each produce 16
bit frequency data once per major frame. Since the calorimeter
data is located in the PASP+ Housekeeping data stream, the
original requirement for a Contamination File has been
incorporated into the Housekeeping / Sun Sensor / Contamination
file. In addition, the file will contain the Power Byte, the A/D
offset byte (necessary for conversion of analog counts to
voltage), the 12 bit HV bias (measured), the 8 bit HV bias
setting, the 'VSUP' and 'TEMP' from the TPM 'first packet' (the
values are bytes 21 and 22, respectively, of TPM packet 1), the
array RTDs (bytes 16-41 from minor frame 9), the bias status
bytes, the controller status bytes, and the command echo. All 12
bit data (e.g. housekeeping and HV bias) will be right justified
in two consecutive bytes.

HEADER RECORD FORMAT

Word
Number   Description

   (All words are 32-bit integers)

   1   Vehicle ID (901)
   2   File ID (21)
   3   Year (e.g. 1991)
   4   Day of Year
   5   UT at start of Data (Milliseconds)
   6   UT at end of Data (Milliseconds)
   7-116   Vacant

13

DATA RECORD FORMAT

Byte Number	Description
1-4	UT(MS) on minor frame 0 of PASP+ major frame
5	A/D offset from minor frame 0
6-7	Subcommed housekeeping analogs from minor frame 0
8-9	HV Bias from minor frame 0
10	Pasp+ sun sensor (Axis A) from minor frame 0
11	Pasp+ sun sensor (Axis B) from minor frame 0
12	Power Byte from minor frame 0
13	TPM VSUP from minor frame 0
14	TPM TEMP from minor frame 0
15-16	Command Echo from minor frame 0
17-18	Controller status bytes from minor frame 0
19-32	Repeat order of bytes 5-18 for minor frame 1
33-46	Repeat order of bytes 5-18 for minor frame 2
.	.
.	.
411-424	Repeat order of bytes 5-18 for minor frame 29
425-426	QCM (DP frequency)
427-428	QCM (PS frequency)
429	HV setting (byte 109 from telemetry minor frame 6)
430-431	Bias status bytes
432-457	Array RTD bytes
458	Data Quality Flag (0 = no telemetry dropout in this major frame; 1 = there was telemetry dropout in this major frame)
459	Sun / Shade indicator; (0 = full major frame in sun; 1 = full major frame in shade; n, where $100 \leq n \leq 129$ = spacecraft transitions from sun to shade on minor frame n-100; m, where $200 \leq m \leq 229$ = spacecraft transitions from shade to sun on minor frame m-200)
460-464	Vacant

Note 1:

The order of the subcommutated analogs is as follows:

Minor Frame	Description
0-4	None
5	+28V MON
6	+15V MON
7	+5V MON
8	-15V MON
9	-5V MON
10	ESA LV MON (see note 2)
11	ESA HV MON (see note 2)
12	Sun Sensor +10V MON
13	RTD Ref
14	None
15	DP QCM Temp
16	PS QCM Temp

14

```
        17              CAL1 Temp
        18              CAL2 Temp
        19              CAL3 Temp
        20              0° RTD
        21              None
        22              Controller Temp
        23              ESA Temp
        24              Langmuir Temp
        25              Emitter Temp
     26-29             None
```

Note 2:

The HVMON values for the 10 ESA channels are sub-subcommutated as a function of the 4 LSBs of the Major Frame Counter as shown below:

MF(mod 16)	HVMON	MF(mod 16)	HVMON
0	Energy1	8	Energy9
1	Energy2	9	Energy10
2	Energy3	10	N/A
3	Energy4	11	N/A
4	Energy5	12	N/A
5	Energy6	13	N/A
6	Energy7	14	N/A
7	Energy8	15	N/A

2.7   EMITTER FILE

The Emitter has 2 filaments, and is expected to last for approximately 600 hours of operation (with several turn-on, turn-off sequences). The Emitter file will be generated only for those periods when the Emitter is 'on'.

The Emitter data consists of 6 bytes (bytes 166-171) every minor frame. The 'power byte' which indicates emitter on/off status will be included in the Emitter File along with the A/D offset byte and the Bias Status bytes.

The emitter data block contains six 8-bit analogs in the following order: A/B monitor, LV monitor, Emission monitor, BIAS monitor, Heater monitor, and GRID current monitor setting. Note that the A/D offset (byte 160) must be divided by 16 before correcting the counts. The emitter monitors readout on a given minor frame were sampled during the previous minor frame. The measured HV Bias (4 LSBs of telemetry byte 162 + byte 163) is also contained on the file. The polarity of the HV Bias is contained in bit 7 of byte 110 (MF 6).

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HEADER RECORD FORMAT

**Word
Number   Description**

  (All words are 32-bit integers)

1	Vehicle ID (901)
2	File ID (22)
3	Year (e.g. 1991)
4	Day of Year
5	UT at start of Data (Milliseconds)
6	UT at end of Data (Milliseconds)
7-78	Vacant

DATA RECORD FORMAT

**Byte
Number   Description**

1-4	UT(MS) on minor frame 0 of Pasp+ major frame
5-10	Emitter data from minor frame 0
11	Power byte from minor frame 0
12	A/D offset byte from minor frame 0
13-14	Measured HV Bias (12 bits right adjusted)
15-24	Repeat word order of bytes 5-14 for minor frame 1
.	. . .
.	. . .
.	. . .
295-304	Repeat word order of bytes 5-14 for minor frame 29
305	Vacant
306	Data Quality Flag (0 = no telemetry dropout in this major frame; 1 = there was telemetry dropout in this major frame)
307	Sun / Shade indicator; (0 = full major frame in sun; 1 = full major frame in shade; n, where $100 \leq n \leq 129$ = spacecraft transitions from sun to shade on minor frame n-100; m, where $200 \leq m \leq 229$ = spacecraft transitions from shade to sun on minor frame m-200)
308-310	Bias Status bytes (bytes 109-111 of minor frame 6)
311-312	Vacant

2.8   IV FILES

There will be 4 IV files generated for dissemination to the outside user community. Data from the following arrays will be grouped together:
-     0, 8, 11
-     0, 12, 13, 15
-     0, 10
-     0, 5, 9, 14

In addition, a single file containing the data from all IVs will be generated for in-house use.

Files containing data from multiple arrays will simply have the data sets interlaced throughout the file.

There are 66 I-V points per IV curve. The first point of each curve is (Vsc,Isc) and the last point is (Voc,Ioc). The middle 64 pairs of points are contained in 192 bytes of I-V readout. Each I-V pair is 24 bits; 12 bits for I and 12 bits for V. Files will include RTD, Isc, Vsc, Ioc, Voc, A/D converter byte, Controller Status byte and the Bias Bytes. The Ioc will be used to correct the current measurements, rather than the A/D converter byte.

There are 4 'modes'
- Background IV
- 'Update' all IVs
- Continuous IV
- Bias

The Controller Status bytes (telemetry bytes 164 and 165) has a flag bit to indicate when 'Continuous IV' is in progress and a bit to indicate when 'Update all IVs' is in progress; Controller Status byte 164 has bits to indicate which array is being updated; . The Bias status byte (telemetry bytes 110-111) has a bit to indicate that the bias is active.

- In Background IV mode, there is no biasing, no Continuous IV, no updating of all IV's. In this case, one IV is updated every major frame. The 'Extra IV' information can be ignored.

- Continuous IV is not expected to be used very often. When it is, the 'Continuous IV' bit will be set on the controller status word. In this case, the 'Extra IV' locations contain the 'background IV' curve from the panel defined by the major frame vs. panel table (see below). All other IVs are being taken on the array commanded for continuous IV. The continuous IV data is stored in the minor frame word locations which normally receive the background IV data. There will be 8 IV curves for the same panel each major frame.

- Bias ON data. When the bias is active, this is indicated by a discrete in the bias status bytes. These bytes (bytes 110-111) also contain discretes fully defining the bias configuration. The IV data for the biased array is stored in the 'Extra IV' word locations - thus, there is one curve each major frame. The data in the remaining IV locations is the background IV data.

- Update all IVs. When the Controller status byte indicates "update all IVs", the implementation of the updating will

occur starting at minor frame 0 of the NEXT major frame.
All IVs will be updated over the next 2 major frames.
Depending on the timing of the command, the updating could
be for arrays 0-7 on one major frame followed by arrays 8-15
on the next, or conversely. If the 4 LSBs of the major
frame counter are even, the curves being updated are 0-7; if
it is odd, the curves are 8-15. The 'Extra IV' locations
have no use during 'update all IVs'.

An IV curve for one array telemetered once per major frame; 8
minutes are required for the IV curves for all arrays to be
completely updated (unless an 'Update All IVs' command is sent).
Arrays 0-7 are sampled on even major frames; 8-15 on odd major
frames. The cycle repeats starting at major frame multiples of
16. These are called background IVs because this scheme operates
continuously, independent of operating mode. The table below
summarizes the major frame / array sampled relationship:

LS 4 bits of Major Frame	Array Samples
0	0
1	8
2	1
3	9
4	2
5	10
6	3
7	11
8	4
9	12
10	5
11	13
12	6
13	14
14	7
15	15

The telemetry words for the 'extra IV' can be used for several
purposes. During biasing, an IV is taken on the biased array
just before each bias step (i.e. once per major frame). Because
a specific IV in the above scheme only gets downlinked every
major frame, the IV for the biased array is telemetered as the
extra IV, independent of the above scheme. Also, since the
entire IV block is used during continuous biasing, the scheduled
background IV is downlinked as the extra IV. In this case, the
above table indicates from which array the extra IV is taken.

The Array RTD, Isc, Vsc, Ioc and Voc measurements are located on
telemetry bytes 16-105 of minor frames 12-13. Minor frame 12
contains data from arrays 0-7 and the extra IV while minor frame
13 contains data from arrays 8-15. Each RTD in this set is taken
immediately prior to an IV curve being taken on the respective
array. The data is 12 bit (stored in 2 bytes with the 4 MSBs of
the first byte set to zero) and the format starting at byte 16 of

minor frame 12 is: RTD(0), Isc(0), Vsc(0), Ioc(0), and Voc(0).
This pattern repeats for arrays 1-7 and the extra IV. Data for
arrays 8-15 is located on telemetry minor frame 13.

The PASP+ Sun Sensor angle values (AXIS A AND AXIS B) are sampled
twice per minor frame. The first of each of these values will be
extracted from the minor frame on which the array data is readout
and stored on this file.

HEADER RECORD FORMAT

**Word
Number**   **Description**

    (All words are 32-bit integers)

    1   Vehicle ID (901)
    2   File ID (23)
    3   Year (e.g. 1991)
    4   Day of Year
    5   UT at start of Data (Milliseconds)
    6   UT at end of Data (Milliseconds)
  7-56   Vacant

DATA RECORD FORMAT

**Byte
Number**   **Description**
    1-4   UT(MS) at start of minor frame on which the array
                     data was stored in the telemetry stream.
    5   Array number (0-15)
   6-197   I-V data bytes
 198-199   RTD for selected array
 200-201   Isc for selected array
 202-203   Vsc for selected array
 204-205   Ioc for selected array
 206-207   Voc for selected array
    208   A/D offset byte
 209-210   Controller status bytes
 211-213   Bias status bytes (bytes 109,110,111 of MF 6)
    214   Mode for this data set (0 = background IV;
                     1=Update IV; 2 = Continuous IV; 4 = Bias)
 215-216   HV Bias Measurement (extracted from 4 LSBs of
                     minor frame word 162, and all of byte 163)
    217   Data Quality Flag (0 = no telemetry dropout in
                     this major frame; 1 = there was telemetry dropout
                     in this major frame)
    218   Sun / Shade indicator; (0 = full major frame in
                     sun; 1 = full major frame in shade; n, where
                     $100 \leq n \leq 129$ = spacecraft transitions from sun to
                     shade on minor frame n-100; m, where $200 \leq m \leq 229$ =
                     spacecraft transitions from shade to sun on minor
                     frame m-200)

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```
219           PASP+ Axis A Sun Sensor Angle (byte 172)
220           PASP+ Axis B Sun Sensor Angle (byte 173)
221-222       RTDREF (12 bits right adjusted in these 16 bits)
223           A/D offset from minor frame containing RTDREF
224           Vacant
```

2.9   ESA FILE

The ESA data consists of 10 sets of counts corresponding to
energies 1-10. Each set consists of four 16 bit counts in the
order ION-HI MSB, ION-HI LSB, ION-LO MSB, ION-LO LSB, ELEC-LO
MSB, ELEC-LO LSB, ELEC-HI MSB, ELEC-HI LSB (thus there are 20
point spectra for both electrons and ions). The 16 bit data is
accumulated counts (i.e. the counts are not logarithmically
compressed). The accumulation period for all counts is 25/256
sec. All ESA data in a given minor frame was accumulated during
the previous minor frame. In addition to the ESA data, the power
byte is included on the file.

The approximate energy range is 10eV-30keV. The data reads out
from ENERGY(1)=highest to ENERGY(10)=lowest for each head. The
highest energy on the low energy head equals the lowest energy on
the high energy head.

In addition to the ESA data, the file contains the power byte (to
determine Emitter on/off status) and Bias bytes 109-111 (to
determine bias on/off status) and the HV Bias measurement (a 12
bit value made up of the 4 least significant bits of telemetry
byte 162 plus telemetry byte 163).

HEADER RECORD FORMAT

Word
Number   Description

   (All words are 32-bit integers)

   1   Vehicle ID (901)
   2   File ID (24)
   3   Year (e.g. 1991)
   4   Day of Year
   5   UT at start of Data (Milliseconds)
   6   UT at end of Data (Milliseconds)
   7-626   Vacant

DATA RECORD FORMAT

Byte
Number   Description
   1-4   UT(MS) on minor frame 0 of Pasp+ major frame
   5-24   10 point Ion-Hi spectra from minor frame 0

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```

| | |
|---|---|
| 25-44 | 10 point Ion-Lo spectra from minor frame 0 |
| 45-64 | 10 point Electron-Hi spectra from minor frame 0 |
| 65-84 | 10 point Electron-Lo spectra from minor frame 0 |
| 85 | Power byte (byte 112 of minor frame 0) |
| 86-87 | HV Bias (12 bits right adjusted) - minor frame 0 |
| 88-170 | Repeat word order of bytes 5-87 for minor frame 1 |
| . | . . . |
| . | . . . |
| . | . . . |
| 2412-2494 | Repeat word order of bytes 5-87 for minor frame 29 |
| 2495 | Data Quality Flag (0 = no telemetry dropout in this major frame; 1 = there was telemetry dropout in this major frame) |
| 2496-2498 | Bias status bytes 109-111 from minor frame 6 |
| 2499 | Sun / Shade indicator; ( 0 = full major frame in sun; 1 = full major frame in shade; n, where $100 \leq n \leq 129$ = spacecraft transitions from sun to shade on minor frame n-100; m, where $200 \leq m \leq 229$ = spacecraft transitions from shade to sun on minor frame m-200) |
| 2500-2504 | Vacant |

## 2.10    TPM FILE

The TPM data is readout as 44 bytes (bytes 116-159) on every minor telemetry frame.

This data set consists of two 22 byte packets.  The least significant bit of the first word of each packet identifies the packet number.  The 'first packet' has a least significant bit of 0 and the 'second packet' has a least significant bit of 1.

In addition, the file will include the bias status (byte 109, 110, 111 of minor frame 6) and the emitter on/off status (power byte - byte 112), and the HV Bias measurement (this is a 12 bit value contained in the 4 LSBs of byte 162 and all of byte 163).

**HEADER RECORD FORMAT**

**Word**
**Number**          **Description**

(All words are 32-bit integers)

| | |
|---|---|
| 1 | Vehicle ID   (901) |
| 2 | File ID (251) |
| 3 | Year (e.g. 1991) |
| 4 | Day of Year |
| 5 | UT at start of Data (Milliseconds) |
| 6 | UT at end of Data (Milliseconds) |
| 7-356 | Vacant |

**DATA RECORD FORMAT**

**Byte**
| **Number** | **Description** |
|---|---|
| 1-4 | UT(MS) on minor frame 0 of Pasp+ major frame |
| 5-48 | 44 byte TPM data from minor frame 0 |
| 49 | Power byte from minor frame 0 |
| 50-51 | HV Bias measurement from minor frame 0 |
| 52-98 | Repeat word order of bytes 5-51 for minor frame 1 |
| . . . | . . . |
| 1368-1414 | Repeat word order of bytes 5-51 for minor frame 29 |
| 1415-1417 | Three bias status bytes (telemetry bytes 109,110, and 111 from minor frame 6) |
| 1418 | Data Quality Flag (0 = no telemetry dropout in this major frame; 1 = there was telemetry dropout in this major frame) |
| 1419 | Sun / Shade indicator; ( 0 = full major frame in sun; 1 = full major frame in shade; n, where $100 \leq n \leq 129$ = spacecraft transitions from sun to shade on minor frame n-100; m, where $200 \leq m \leq 229$ = spacecraft transitions from shade to sun on minor frame m-200) |
| 1420-1424 | Vacant |

Note: The TPM word order for the 'first packet' and 'second packet' is as follows:

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| First Packet | Word No. | Second Packet |
|---|---|---|
| Sequence count (even) | 1 | Sequence Count (odd) |
| Pos Amplitude 0 | 2 | PAMP3 |
| Neg Amplitude 0 | 3 | NAMP3 |
| Pos Derivative 0 | 4 | PDER3 |
| Neg Derivative 0 | 5 | NDER3 |
| Integral 0 | 6 | INT3 |
| PAMP2 | 7 | PAMP4 |
| NAMP2 | 8 | NAMP4 |
| PDER2 | 9 | PDER4 |
| NDER2 | 10 | NDER4 |
| INT2 | 11 | INT4 |
| PAMP1 | 12 | PAMP5 |
| NAMP1 | 13 | NAMP5 |
| PDER1 | 14 | PDER5 |
| NDER1 | 15 | NDER5 |
| INT1 | 16 | INT5 |
| CT5 AND CT4 (4 BITS) | 17 | THRSH 3,2,1,0,2BITS |
| CT2 AND CT1 (4 BITS ) | 18 | THRSH 5,4 + CMD |
| CT1 AND CT0 (4 BITS) | 19 | Parity |
| Pulse Cycles | 20 | Parity |
| VSUP | 21 | Parity |
| Temp | 22 | Parity |

## 2.11    LEAKAGE CURRENT FILE

The Electrometer data is meaningful only when the bias is active
(i.e., bit 7 of minor frame word 111 of minor frame 6 is set to
1).  Hence, the file will be generated only when the bias is on.
The electrometer data consists of 8 bytes readout on minor frames
7-29.  Since the electrometer data consists of five 12 bit words,
each of the five values will be right justified in 2 bytes.  In
addition to the electrometer bytes, the file will contain the
bias status (telemetry bytes 109, 110, 111 of minor frame 6), the
emitter on/off status (power byte – telemetry byte 112), the HV
bias (12 bits extracted from 4 LSBs of minor frame word 162, plus
byte 163), the Grid Current, and the A/D offset byte (telemetry
byte 160)

## HEADER RECORD FORMAT

**Word
Number          Description**

(All words are 32-bit integers)

| | |
|---|---|
| 1 | Vehicle ID   (901) |
| 2 | File ID (26) |
| 3 | Year (e.g. 1991) |
| 4 | Day of Year |

| | |
|---|---|
| 5 | UT at start of Data (Milliseconds) |
| 6 | UT at end of Data (Milliseconds) |
| 7-90 | Vacant |

**DATA RECORD FORMAT**

| Byte Number | Description |
|---|---|
| 1-4 | UT(MS) on minor frame 0 of Pasp+ major frame |
| 5-14 | Five electrometer samples from minor frame 7 |
| 15 | Emitter on/off status (telemetry byte 112) from minor frame 6 |
| 16 | A/D offset byte (telemetry byte 160) from minor frame 6 |
| 17-18 | HV Bias measurement from minor frame 6 |
| 19 | Grid Current (byte 171) from minor frame 6 |
| 20-34 | Repeat word order of bytes 5-18 for data from minor frame 7 and 8 |
| . | . |
| . | . |
| . | . |
| 335-349 | Repeat word order of bytes 5-18 for minor frame 28 and 29 |
| 350-352 | Three bias status bytes (telemetry bytes 109,110, and 111 from minor frame 6) |
| 353 | Data Quality Flag (0 = no telemetry dropout in this major frame; 1 = there was telemetry dropout in this major frame) |
| 354 | Sun / Shade indicator; ( 0 = full major frame in sun; 1 = full major frame in shade; n, where $100 \leq n \leq 129$ = spacecraft transitions from sun to shade on minor frame n-100; m, where $200 \leq m \leq 229$ = spacecraft transitions from shade to sun on minor frame m-200) |
| 355-360 | Vacant |

## 2.12    LANGMUIR PROBE PRE-PROCESSED FILE

There are 4 scans per major frame - each one of duration 1 second.  The data is sampled on minor frames 0-3 and is read out in adjacent pairs of minor frames (e.g. 1,2 then 3,4...).  There are a total of 72 bytes per minor frame.  64 are for Ne, and 8 are for bias; thus, over 2 frames, there are 128 Ne points, and 16 Bias points.  The bias voltage runs in sync with the TLM system.

The bias behaves as follows:
1st second: sweep -4 -> +4
2nd second: sweep +4 -> -4
Next 2 seconds: hold at +1 volt.

The A/D offset and the power byte will be included in this file as well and the Langmuir Temperature data (from the subcommutated housekeeping).

**HEADER RECORD FORMAT**

**Word
Number**            **Description**

(All words are 32-bit integers)

| | |
|---|---|
| 1 | Vehicle ID  (901) |
| 2 | File ID (27) |
| 3 | Year (e.g. 1991) |
| 4 | Day of Year |
| 5 | UT at start of Data (Milliseconds) |
| 6 | UT at end of Data (Milliseconds) |
| 7-150 | Vacant |

**DATA RECORD FORMAT**

**Byte
Number**            **Description**

| | |
|---|---|
| 1-4 | UT(MS) on minor frame 0 of Pasp+ major frame |
| 5-148 | 128 electron density points followed by 16 bias points from telemetry minor frames 1 and 2 |
| 149 | A/D offset byte from minor frame 0 |
| 150 | Power Byte from minor frame 0 |
| 151-294 | 128 electron density points followed by 16 bias points from telemetry minor frames 3 and 4 |
| 295 | A/D offset byte from minor frame 1 |
| 296 | Power Byte from minor frame 1 |
| 297-440 | 128 electron density points followed by 16 bias points from telemetry minor frames 5 and 6 |
| 441 | A/D offset byte from minor frame 2 |
| 442 | Power Byte from minor frame 2 |
| 443-586 | 128 electron density points followed by 16 bias points from telemetry minor frames 7 and 8 |
| 587 | A/D offset byte from minor frame 3 |
| 588 | Power Byte from minor frame 3 |
| 589 | Power Byte from minor frame 4 |
| 590 | Power Byte from minor frame 5 |
| 591 | Power Byte from minor frame 6 |
| 592 | Power Byte from minor frame 7 |
| 593 | Power Byte from minor frame 8 |
| 594-595 | Langmuir temperature (from Pasp+ housekeeping data; this is 12 bit data right justified in the 2 bytes - the temperature value is located on housekeeping minor frame 24) |
| 596 | A/D offset from minor frame 24 |
| 597 | Data Quality Flag (0 = no telemetry dropout in this major frame; 1 = there was telemetry dropout in this major frame) |

| 598 | Sun / Shade indicator; ( 0 = full major frame in sun; 1 = full major frame in shade; n, where $100 \le n \le 129$ = spacecraft transitions from sun to shade on minor frame n-100; m, where $200 \le m \le 229$ = spacecraft transitions from shade to sun on minor frame m-200) |
| 599-600 | Vacant |

## 2.12.1    LANGMUIR PROBE DENSITY/TEMPERATURE/SENPOT FILE

The Langmuir Probe data is processed as a two phase effort.  The initial effort extracts all parameters necessary for input to the Langmuir Analysis routine.  The file described below is the final data set from the Langmuir Analysis.  All words are 32-bit non-negative integers in big-endian architecture.

**HEADER RECORD FORMAT**

**Wd Number  Description**

| 1 | Vehicle ID (901) |
| 2 | File ID (127) |
| 3 | Year (e.g. 1993) |
| 4 | Day of Year |
| 5 | UT at start of Data (Milliseconds) |
| 6 | UT at end of Data (Milliseconds) |
| 7-8 | Vacant |

**DATA RECORD FORMAT**

**Wd Number  Description**

| 1 | UT (Milliseconds) |
| 2 | Electron Density (CM**-3) (invalid values =0) |
| 3 | Electron Temperature (deg K) X 1000 (invalid values =0) |
| 4 | [Langmuir Temperature (deg C)+100] X 1000, from PASP+ housekeeping (invalid values = 0) |
| 5 | Sun/Shade indicator (0=in sun, 1=in shade, 2=spacecraft transitions from sun to shade, 3=spacecraft transitions from shade to sun) |
| 6 | Power Byte |
| 7 | Sweep Direction Indicator (1=Sweep up; 2=Sweep down) |
| 8 | [Senpot (volts) + 100] X 1000 (invalid values = 0) |

Note:
Invalid numbers are stored on the file as 0.

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## 2.13     SPECIAL THDB FILES

Four special THDB files are to be generated.  A mini-ephemeris
file with sun sensor data will be generated for use by Phillips
Laboratory and NASA/Lewis personnel working on solar panel data.
Since neither the Phillips Laboratory nor NASA/Lewis requires the
ESA or Dosimeter data at the full data rate, a 15 second averaged
ESA file and a 24 second averaged Dosimeter file will be
generated.  These two averaged files will be the THDB product
provided to Phillips Laboratory and NASA/Lewis for the ESA and
Dosimeter.  A THDB file of Global Positioning Satellite (GPS)
data is to be generated for use by PL/GPD for special GPS
studies.


### 2.13.1     MINI-EPHEMERIS / SUN SENSOR FILE

This THDB file contains a subset of the parameters on the
standard THDB ephemeris file as well as sun sensor data.  The
data in words 1-8 and word 15-18 is in 32 bit positive integer
form (31 data bits and the MSB set equal to 0) with offset and
bias values are provided to convert the positive integer values
to true units.  The ephemeris data will be generated at a rate of
once per minute. To convert the 32-bit positive integers into
proper units, subtract $2**30$ from the value and then multiply by
the appropriate factor.  All factors are in powers of 10.  The
format below gives the appropriate multiplicative factor for each
word on the ephemeris file (e.g. if power is 2, then multiply the
integer word by $10**2$ after subtracting $2**30$).

In addition to the selected ephemeris parameters, the sun sensor
data from the PASP+ and OSC spacecraft sun sensors will be
included.  Both sun sensor packages readout two sun angles.  The
sun sensor data will be stored in raw form.  The PASP+ sun sensor
data is acquired every second.  The measurement closest in time
to the time of the ephemeris data will be the set of measurements
selected.  The spacecraft sun sensor data will be extracted from
the Spacecraft State of Health file.  This data occurs at a rate
of one frame per minute.  Since the time tags on the PASP+ sun
sensor readouts and Spacecraft SOH file will most likely not
match identically with the ephemeris time, the readout closest in
time to the ephemeris time will be selected.  If a value of the
PASP+ sun sensor or the SOH data does not have a time tag to
within one minute of the ephemeris time, the values will be dummy
(0 filled) and a flag set to indicate invalid data.

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**HEADER RECORD FORMAT**

| Word Number | Description |
|---|---|
| 1 | Vehicle ID  (901) |
| 2 | File ID (31) |
| 3 | Year (e.g. 1991) |
| 4 | Day of Year |
| 5 | UT at start of Data (Milliseconds) |
| 6 | UT at end of Data (Milliseconds) |
| 7-31 | Vacant |

**DATA RECORD FORMAT**

| Word Number | Description | Factor |
|---|---|---|
| 1 | Julian Date(Days) | 0 |
| 2 | UT (Milliseconds) | 0 |
| 3 | X, Satellite Position, ECI (Km) | -4 |
| 4 | Y, Satellite Position, ECI (Km) | -4 |
| 5 | Z, Satellite Position, ECI (Km) | -4 |
| 6 | Geodetic Altitude (Km) | -4 |
| 7 | Geocentric Latitude (Deg) | -6 |
| 8 | Longitude (Deg) (+E) | -6 |
| 9 | Geomagnetic Latitude | -6 |
| 10 | Magnetic Local Time | -7 |
| 11 | L-Shell | -6 |
| 12 | Rev. No. | 1 |
| 13 | Vx, Satellite Velocity, ECI (Km/Sec) | -7 |
| 14 | Vy, Satellite Velocity, ECI (Km/Sec) | -7 |
| 15 | Vz, Satellite Velocity, ECI (Km/Sec) | -7 |
| 16 | X Sun Position-ECI (Km) | 0 |
| 17 | Y Sun Position-ECI (Km) | 0 |
| 18 | Z Sun Position-ECI (Km) | 0 |
| 19 | UT (ms) of PASP+ sun sensor data | |
| 20 | MS Byte (Byte 3) AXIS A data (TLM byte) | |
| | Byte 2 AXIS B data (TLM byte) | |
| | Byte 1 = PASP+ sun sensor flag;<br>(1=invalid data-dummy filled) | |
| | Byte 0 = spacecraft sun sensor flag; 1=<br>invalid data - dummy filled) | |
| 21 | UT (ms) of spacecraft sun sensor data | |
| 22 | Sun Sensor Data time tag delta(from telemetry) | |
| 23 | Byte 3 and Byte 2) - Spacecraft sun<br>sensor angle 1 (16 bits) | |
| | Byte 1 and Byte 0 - Spacecraft sun<br>sensor angle 2 (16 bits) | |
| 24 | Bit 1 - Sun presence detected by<br>sun sensor 1 (1=yes) | |
| | Bit 0 (LSB of word 14) Sun presence | |

|    |                                          |
|----|------------------------------------------|
|    | detected by sun sensor 2 (1=yes)         |
| 25 | Solar Array #1 Current                   |
| 26 | Solar Array #1 Temperature               |
| 27 | Solar Array #2 Current                   |
| 28 | Solar Array #2 Temperature               |
| 29 | Solar Array #3 Current                   |
| 30 | Solar Array #3 Temperature               |
| 31 | Solar Array Input Voltage                |

## 2.13.2    AVERAGED ESA FILE

The approximate energy range for the ESA data is 10eV-30keV. The data will be averaged in 15 second intervals (half a major frame). In addition to the ESA data, the file contains the power byte (to determine Emitter on/off status) and Bias bytes 109-111 (to determine bias on/off status). Since the 15 second averages will be computed over telemetry minor frames 0-14 and 15-29, the power byte will be taken from the frame at the center of the averaging interval (e.g. from minor frame 7 when the average is computed over minor frames 0-15).

Should telemetry dropout have occurred on the major frame containing the data set, the '1's' filled minor frames on the Agency Tape will not be included in the averages. If no valid data is available for an averaging period, a record of data will not be generated.

### HEADER RECORD FORMAT

**Word Number**      **Description**

|          |                                       |
|----------|---------------------------------------|
|          | (All words are 32-bit integers)       |
| 1        | Vehicle ID  (901)                     |
| 2        | File ID (32)                          |
| 3        | Year (e.g. 1991)                      |
| 4        | Day of Year                           |
| 5        | UT at start of Data (Milliseconds)    |
| 6        | UT at end of Data (Milliseconds)      |
| 7-46     | Vacant                                |

### DATA RECORD FORMAT

Words 1-43 of the data records may be considered as 32 bit positive integers; word 44 contains 4 telemetry bytes.

**Word Number**      **Description**

|          |                                                    |
|----------|----------------------------------------------------|
| 1        | UT(MS) at center of 15 second averaging interval   |
| 2-11     | Averaged Ion-Hi spectra (each value * 100)         |
| 12-21    | Averaged Ion-Lo spectra (each value * 100)         |

| | |
|---|---|
| 22-31 | Averaged Electron-Hi spectra (each value *100) |
| 32-41 | Averaged Electron-Lo spectra (each value * 100) |
| 42 | LS byte of word 42 is Power byte (byte 112 of minor frame 7 or 22); the 3 MS bytes of this word are vacant. |
| 43 | LS byte of word 43 is Data Quality Flag (0 = no telemetry dropout in this major frame; 1 = there was telemetry dropout in this major frame) |
| 44 | Bias status bytes 109-111 from minor frame 6 followed by a vacant byte |
| 45 | Sun / Shade indicator; ( 0 = full major frame in sun; 1 = full major frame in shade; n, where $100 \leq n \leq 129$ = spacecraft transitions from sun to shade on minor frame n-100; m, where $200 \leq m \leq 229$ = spacecraft transitions from shade to sun on minor frame m-200) |
| 46 | Vacant |

## 2.13.3     AVERAGED DOSIMETER FILE

The Averaged Dosimeter THDB file contains 24 second averaged values for the event counts measured by each of the 6 sensors as well as the dose counts (non-averaged) from each of the sensors. The last occurrence of dose counts in each 24 second interval is the sample selected for this file.  Only data from normal mode is used in the generation of this file.  Should telemetry dropout have occurred on the major frame containing the data set, the '1's' filled minor frames on the Agency Tape will not be included in the averages.  In the event that an individual average cannot not be taken because all of the data was missing due to telemetry dropout, the value stored on the file will be set to $2^{31} - 1$.

**AVERAGED DOSIMETER FILE HEADER RECORD FORMAT**

All words are 32-bit positive integers.

| Word Number | Description |
|---|---|
| 1 | Vehicle ID (901) |
| 2 | File ID (33) |
| 3 | Year (e.g. 1991) |
| 4 | Day of Year |
| 5 | UT at start of Data (Milliseconds) |
| 6 | UT at end of Data (Milliseconds) |
| 7-58 | Vacant |

**AVERAGED DOSIMETER FILE DATA RECORD FORMAT**

| Word Number | Description |
|---|---|

| 1 | UT (Milliseconds) at center of averaging interval |
|---|---|
| 2 | Averaged VHILET COUNT*FACTOR (*) Detector D1A |
| 3 | Averaged TOTAL COUNT*FACTOR (*) Detector D1A |
| 4 | Averaged LOLET COUNT*FACTOR (*) Detector D1A |
| 5 | Averaged HILETA COUNT*FACTOR (*) Detector D1A |
| 6 | Averaged HILETB COUNT*FACTOR(*) Detector D1A |
| 7-8 | LOLET DOSE - Detector D1A (48 data bits right adjusted in these words ) |
| 9-10 | HILET DOSE - Detector D1A (48 data bits right adjusted in these words) |
| 11-19 | Repeat order of words 2-10 for detector D1B |
| 20-28 | Repeat order of words 2-10 for detector D2A |
| 29-37 | Repeat order of words 2-10 for detector D2B |
| 38-46 | Repeat order of words 2-10 for detector D3 |
| 47-55 | Repeat order of words 2-10 for detector D4 |
| 56 | Dropout Flag (Value = 1 if any minor frames within the major frame were 1's filled) |
| 57-58 | Vacant |

(*) The multiplicative factor (FACTOR) is 1 for the LOLET and TOTAL channels of detector D1B and 4 for all other channels and detectors.

## 2.13.4 GPS FILE

The GPS data for this file has been extracted from the Spacecraft State of Health file. The Spacecraft State of Health file consists of a time tag followed by telemetry bytes 11-1000. In the following list of telemetry byte numbers to be extracted from the State of Health file, the telemetry byte numbering sequence is from 1-1000. The telemetry bytes contained in the file are: 150, 173, 192, 279, 303, 304, and 474-668. This represents a total of 201 telemetry bytes. See the telemetry list in Appendix A to determine the GPS data contained in each byte.

**HEADER RECORD:**

| Word Number | Description |
|---|---|
| 1 | Vehicle ID (901) |
| 2 | File ID (34) |
| 3 | Year (e.g. 1991) |
| 4 | Day of Year |
| 5 | UT at start of Data (Milliseconds) |
| 6 | UT at end of Data (Milliseconds) |
| 7-54 | Vacant |

**DATA RECORD:**

| Byte Number | Description |
|---|---|
| 1-4 | UT (milliseconds) |
| 5-205 | 201 GPS data bytes extracted from spacecraft state of health frame. |
| 206-216 | Vacant |

Note: The GPS data is to be extracted from the Spacecraft State of Health Data using APEX Telemetry list Version 1.11. The description of the data contained within each byte is described below.

| H/W | | Bit | Byte Range | | Bit | IEEE | Engineering | | | Conversion | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| System | Telemetry Point | Len | Start | End | Offset | Units | HI | LO | Type | Slope | Intercept |
| SCM | GPS to SCM Pulse Count | 6 | 150 | 150 | 2 | Int | | | D | decimal | |
| SCM | Good GPS Data Sync | 1 | 150 | 150 | 1 | Y/N | | | B | 0=Sync | 1=Masked |
| SCM | GPS Clock Sync | 1 | 173 | 173 | 0 | Y/N | | | B | 0=GPS | 1=Free |
| PSM | GPS Driver App Status | 1 | 192 | 192 | 4 | Y/N | | | B | 0=Pass | 1=Fail |
| BCR | Load Shed Priority GPS | 2 | 279 | 279 | 4 | Y/N | | | B | 0=Lvl 1 | 1=Lvl 2 |
| BCR | GPS Mode | 2 | 303 | 303 | 6 | Y/N | | | B | 0=PROM | 1=Commd |
| BCR | GPS Shutdwn Lim Exceed | 1 | 303 | 303 | 5 | Y/N | | | B | 0=Nom | 1=Shutd |
| BCR | GPS Overload Detect | 1 | 303 | 303 | 4 | Y/N | | | B | 0=Nom | 1=Warn |
| BCR | GPS Overload Params | 1 | 303 | 303 | 3 | Y/N | | | B | 0=Runtm | 1=Start |
| BCR | GPS Action Status | 1 | 303 | 303 | 2 | Y/N | | | B | 0=Comp | 1=Pend |
| BCR | GPS Auto | 1 | 303 | 303 | 1 | Y/N | | | B | 0=Cmd | 1=Auto |
| BCR | GPS On/Off | 1 | 303 | 303 | 0 | Y/N | | | B | 0=Off | 1=On |
| BCR | GPS Load Current | 8 | 304 | 304 | 0 | Amps | 5.28 | -0.28 | P | 0.0218 | -0.284 |
| GPS | GPS Clock Offset | 4 | 474 | 474 | 4 | Int | | | P | 100 | 0 |
| GPS | GPS App Error Count | 3 | 474 | 474 | 1 | Int | | | D | decimal | |
| GPS | GPS Packet Status | 1 | 474 | 474 | 0 | Y/N | | | B | 0=Valid | 1=Miss |
| GPS | X Position (83) | 32 | 475 | 478 | 0 | Meter | | | H | IEEE Single | |
| GPS | Y Position (83) | 32 | 479 | 482 | 0 | Meter | | | H | IEEE Single | |
| GPS | Z Position (83) | 32 | 483 | 486 | 0 | Meter | | | H | IEEE Single | |
| GPS | Time Of Position Fix (83) | 32 | 487 | 490 | 0 | Sec | | | H | IEEE Single | |
| GPS | X Velocity (43) | 32 | 491 | 494 | 0 | M/s | | | H | IEEE Single | |
| GPS | Y Velocity (43) | 32 | 495 | 498 | 0 | M/s | | | H | IEEE Single | |
| GPS | Z Velocity (43) | 32 | 499 | 502 | 0 | M/s | | | H | IEEE Single | |
| GPS | Bias Rate (43) | 32 | 503 | 506 | 0 | M/s | | | H | IEEE Single | |
| GPS | Time Of Velocity Fix (43) | 32 | 507 | 510 | 0 | Sec | | | H | IEEE Single | |
| GPS | Health Code (46) | 8 | 511 | 511 | 0 | | | | H | Table | |
| GPS | Error Code (46) | 8 | 512 | 512 | 0 | | | | H | Table | |
| SCM | GPS Sat. Selection (44h) | 168 | 513 | 533 | 0 | | | | H | Table | |
| SCM | GPS Machine C/S (4Bh) | 24 | 534 | 536 | 0 | | | | H | Table | |
| SCM | GPS Raw Data Sat #1(E4) | 256 | 537 | 568 | 0 | | | | H | Table | |
| SCM | GPS Raw Data Sat #2(E4) | 256 | 569 | 600 | 0 | | | | H | Table | |
| SCM | GPS Raw Data Sat #3(E4) | 256 | 601 | 632 | 0 | | | | H | Table | |
| SCM | GPS Raw Data Sat #4(E4) | 256 | 633 | 664 | 0 | | | | H | Table | |
| SCM | Clock Bias (83) | 32 | 665 | 668 | 0 | | | | H | IEEE Single | |

## 2.14    FILE NAMING CONVENTIONS AND FILE SIZE ESTIMATES

Each THDB file will be named with an 8 character prefix followed by the suffix `.DAT'. The prefix consists of a 3 character designator for the data type, a two digit year indicator, and a 3 digit day of year indicator. For example, the Langmuir Probe Density/Temperature file for day 120 of year 1994 would be named DEN94120.DAT. The list of THDB files, file naming conventions, and approximate file sizes is included below.

| FILE TYPE | FILE NAME PREFIX | FILE SIZE |
|---|---|---|
| | | |
| MINI-EPHEMERIS | MSE | 80kb |
| ATTITUDE / MAGNETIC FIELD | AMF | 52kb |
| AVERAGED DOSIMETER | AVD | 720kb |
| HOUSEKEEPING / SUN SENSOR / CONTAMINATION | HOU | 1.3Mb |
| EMITTER | EMI | .6kb/min of operation |
| IV (TWO SOLAR PANELS) PANELS 0,10 | IV3 | 86kb |
| IV (THREE SOLAR PANELS) PANELS 0, 8, AND 11 | IV1 | 129kb |
| IV (FOUR SOLAR PANELS) PANELS 0, 12, 13, AND 15 | IV2 | 172kb |
| IV (FOUR SOLAR PANELS) PANELS 0, 5, 9, AND 14. | IV4 | 172kb |
| ALL IVS (16 SOLAR PANELS) | IVA | 688kb |
| AVERAGED ESA | AVE | 1.0Mb |
| TPM | TPM | 4.1Mb |
| LEAKAGE CURRENT | LEA | 21kb/minute of bias operation |
| LANGMUIR DENSITY/TEMPERATURE | DEN | 368kb |

Notes:
1. Emitter file is generated only when the Emitter is on. This generates .6kb of data per minute of operation.
2. Leakage Current file is generated only when the bias is on. This generates 21kb of data per minute of operation.


## 3.0 PASP PLUS TELEMETRY DATA

The descriptions of the PASP PLUS telemetry in this chapter have been excerpt or paraphrased from the Amptek, Inc. telemetry description documents.


## 3.1 PASP-PLUS MAJOR FRAME FORMAT

**MINOR FRAME 0:**

| Byte No. | Description |
|---|---|
| 0-3 | Sync |
| 4 | Minor frame No. (Value is 0-29) |
| 5-7 | Major Frame No. (Value is 0-16777215) |
| 8-111 | Spare |

```
     112              Power
     113              Spare
   114-115            Echo
   116-127            TPM Sample 1 (12 bytes)
   128-137            TPM Sample 1 (10 bytes)
   138-143            TPM Sample 2 (6 bytes)
   144-159            TPM Sample 2 (16 bytes)
   160-165            Housekeeping (6 bytes)
   166-171            Emitter (6 bytes)
   172-175            Sun Sensor (4 bytes)
   176-183            ESA Energy 1 (8 bytes)
   184-191            ESA Energy 2 (8 bytes)
   192-199            ESA Energy 3 (8 bytes)
   200-207            ESA Energy 4 (8 bytes)
   208-215            ESA Energy 5 (8 bytes)
   216-223            ESA Energy 6 (8 bytes)
   224-231            ESA Energy 7 (8 bytes)
   232-239            ESA Energy 8 (8 bytes)
   240-247            ESA Energy 9 (8 bytes)
   248-255            ESA Energy 10 (8 bytes)
```

MINOR FRAME 1:
```
   Byte No.           Description
     0-3              Sync
      4               Minor frame No.
     5-7              Major Frame No.
     8-9              QCM1 (2 bytes)
    10-11             QCM2 (2 bytes)
    12-15             Spare
    16-31             Langmuir Probe Scan #0 (16 bytes)
    32-47             Langmuir Probe Scan #0 (16 bytes)
    48-63             Langmuir Probe Scan #0 (16 bytes)
    64-79             Langmuir Probe Scan #0 (16 bytes)
    80-87             Langmuir Probe Scan #0 (8 bytes)
    88-111            Spare
   112-255            Same as minor frame 0
```

MINOR FRAME 2:
```
   Byte No.           Description
     0-3              Sync
      4               Minor frame No.
     5-7              Major Frame No.
     8-15             Spare
    16-31             Langmuir Probe Scan #0 (16 bytes)
    32-47             Langmuir Probe Scan #0 (16 bytes)
    48-63             Langmuir Probe Scan #0 (16 bytes)
    64-79             Langmuir Probe Scan #0 (16 bytes)
    80-87             Langmuir Probe Scan #0 (8 bytes)
    88-111            Spare
   112-255            Same as minor frame 0
```

MINOR FRAME 3 AND MINOR FRAME 4:
```
   Byte No.           Description
     0-3              Sync
```

4	Minor frame No.
5-7	Major Frame No.
8-15	Spare
16-31	Langmuir Probe Scan #1 (16 bytes)
32-47	Langmuir Probe Scan #1 (16 bytes)
48-63	Langmuir Probe Scan #1 (16 bytes)
64-79	Langmuir Probe Scan #1 (16 bytes)
80-87	Langmuir Probe Scan #1 (8 bytes)
88-111	Spare
112-255	Same as minor frame 0

MINOR FRAME 5:

Byte No.	Description
0-3	Sync
4	Minor frame No.
5-7	Major Frame No.
8-15	Spare
16-31	Langmuir Probe Scan #2 (16 bytes)
32-47	Langmuir Probe Scan #2 (16 bytes)
48-63	Langmuir Probe Scan #2 (16 bytes)
64-79	Langmuir Probe Scan #2 (16 bytes)
80-87	Langmuir Probe Scan #2 (8 bytes)
88-111	Spare
112-255	Same as minor frame 0

MINOR FRAME 6:

Byte No.	Description
0-3	Sync
4	Minor frame No.
5-7	Major Frame No.
8-15	Spare (8 bytes)
16-31	Langmuir Probe Scan #2 (16 bytes)
32-47	Langmuir Probe Scan #2 (16 bytes)
48-63	Langmuir Probe Scan #2 (16 bytes)
64-79	Langmuir Probe Scan #2 (16 bytes)
80-87	Langmuir Probe Scan #2 (8 bytes)
88-104	Spare
105-111	Bias Status (7 bytes)
112-255	Same as minor frame 0

MINOR FRAME 7 AND MINOR FRAME 8:

Byte No.	Description
0-3	Sync
4	Minor frame No.
5-7	Major Frame No.
8-15	Electrometer (8 bytes)
16-31	Langmuir Probe Scan #3 (16 bytes)
32-47	Langmuir Probe Scan #3 (16 bytes)
48-63	Langmuir Probe Scan #3 (16 bytes)
64-79	Langmuir Probe Scan #3 (16 bytes)
80-87	Langmuir Probe Scan #3 (8 bytes)
88-111	Spare
112-255	Same as minor frame 0

MINOR FRAME 9:

Byte No.	Description
0-3	Sync
4	Minor frame No.
5-7	Major Frame No.
8-15	Electrometer (8 bytes)
16-41	RTD for Array #1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 14, 13, 15 [in THAT sequence] (26 bytes)
42-111	Spare
112-255	Same as minor frame 0

MINOR FRAME 10:

Byte No.	Description
0-3	Sync
4	Minor frame No.
5-7	Major Frame No.
8-15	Electrometer (8 bytes)
16-111	EXTRA IV Curve. (points 0-31) (6*16 bytes)
112-255	Same as minor frame 0

MINOR FRAME 11

Byte No.	Description
0-3	Sync
4	Minor frame No.
5-7	Major Frame No.
8-15	Electrometer (8 bytes)
16-111	EXTRA IV Curve. (points 32-63) (6*16 bytes)
112-255	Same as minor frame 0

MINOR FRAME 12:

Byte No.	Description
0-3	Sync
4	Minor frame No.
5-7	Major Frame No.
8-15	Electrometer (8 bytes)
16-17	RTD#1 (2 bytes)
18-19	Isc#0 (2 bytes)
20-21	Vsc#0 (2 bytes)
22-23	Ioc#0 (2 bytes)
24-25	Voc#0 (2 bytes)
26-27	RTD#1 (2 bytes)
28-29	Isc#1 (2 bytes)
30-31	Vsc#1 (2 bytes)
32-33	Ioc#1 (2 bytes)
34-35	Voc#1 (2 bytes)
36-37	RTD#1 (2 bytes)
38-39	Isc#2 (2 bytes)
40-41	Vsc#2 (2 bytes)
42-43	Ioc#2 (2 bytes)
44-45	Voc#2 (2 bytes)
46-47	RTD#3 (2 bytes)
48-49	Isc#3 (2 bytes)
50-51	Vsc#3 (2 bytes)
52-53	Ioc#3 (2 bytes)

54-55	Voc#3 (2 bytes)
56-57	RTD#6 (2 bytes)
58-59	Isc#4 (2 bytes)
60-61	Vsc#4 (2 bytes)
62-63	Ioc#4 (2 bytes)
64-65	Voc#4 (2 bytes)
66-67	RTD#5 (2 bytes)
68-69	Isc#5 (2 bytes)
70-71	Vsc#5 (2 bytes)
72-73	Ioc#5 (2 bytes)
74-75	Voc#5 (2 bytes)
76-77	RTD#6 (2 bytes)
78-79	Isc#6 (2 bytes)
80-81	Vsc#6 (2 bytes)
82-83	Ioc#6 (2 bytes)
84-85	Voc#6 (2 bytes)
86-87	RTD#7 (2 bytes)
88-89	Isc#7 (2 bytes)
90-91	Vsc#7 (2 bytes)
92-93	Ioc#7 (2 bytes)
94-95	Voc#7 (2 bytes)
96-97	RTD-Extra IV curve (2 bytes)
98-99	Isc-Extra IV curve (2 bytes)
100-101	Vsc-Extra IV curve (2 bytes)
102-103	Ioc-Extra IV curve (2 bytes)
104-105	Voc-Extra IV curve (2 bytes)
106-111	Spare
112-255	Same as minor frame 0

MINOR FRAME 13:

Byte No.	Description
0-3	Sync
4	Minor frame No.
5-7	Major Frame No.
8-15	Electrometer (8 bytes)
16-17	RTD#8 (2 bytes)
18-19	Isc#8 (2 bytes)
20-21	Vsc#8 (2 bytes)
22-23	Ioc#8 (2 bytes)
24-25	Voc#8 (2 bytes)
26-27	RTD#9 (2 bytes)
28-29	Isc#9 (2 bytes)
30-31	Vsc#9 (2 bytes)
32-33	Ioc#9 (2 bytes)
34-35	Voc#9 (2 bytes)
36-37	RTD#10 (2 bytes)
38-39	Isc#10 (2 bytes)
40-41	Vsc#10 (2 bytes)
42-43	Ioc#10 (2 bytes)
44-45	Voc#10 (2 bytes)
46-47	RTD#11 (2 bytes)
48-49	Isc#11 (2 bytes)
50-51	Vsc#11 (2 bytes)
52-53	Ioc#11 (2 bytes)

```
    54-55            Voc#11 (2 bytes)
    56-57            RTD#12 (2 bytes)
    58-59            Isc#12 (2 bytes)
    60-61            Vsc#12 (2 bytes)
    62-63            Ioc#12 (2 bytes)
    64-65            Voc#12 (2 bytes)
    66-67            RTD#12 (2 bytes)
    68-69            Isc#13 (2 bytes)
    70-71            Vsc#13 (2 bytes)
    72-73            Ioc#13 (2 bytes)
    74-75            Voc#13 (2 bytes)
    76-77            RTD#14 (2 bytes)
    78-79            Isc#14 (2 bytes)
    80-81            Vsc#14 (2 bytes)
    82-83            Ioc#14 (2 bytes)
    84-85            Voc#14 (2 bytes)
    86-87            RTD#13 (2 bytes)
    88-89            Isc#15 (2 bytes)
    90-91            Vsc#15 (2 bytes)
    92-93            Ioc#15 (2 bytes)
    94-95            Voc#15 (2 bytes)
    96-111           Spare
    112-255          Same as minor frame 0
```

MINOR FRAME 14:
```
    Byte No.         Description
    0-3              Sync
    4                Minor frame No.
    5-7              Major Frame No.
    8-15             Electrometer (8 bytes)
    16-111           IV Curve for Array #0 or #8 (points 0-31)
    112-255          Same as minor frame 0
```

MINOR FRAME 15:
```
    Byte No.         Description
    0-3              Sync
    4                Minor frame No.
    5-7              Major Frame No.
    8-15             Electrometer (8 bytes)
    16-111           IV Curve for Array #0 or #8 (points 32-63)
    112-255          Same as minor frame 0
```

MINOR FRAMES 16-17

Same pattern as minor frames 14-15 for Array #1 or Array #9

MINOR FRAMES 18-19

Same pattern as minor frames 14-15 for Array #2 or Array #10

MINOR FRAMES 20-21

Same pattern as minor frames 14-15 for Array #3 or Array #11

MINOR FRAMES 22-23

Same pattern as minor frames 14-15 for Array #4 or Array #12

MINOR FRAMES 24-25

Same pattern as minor frames 14-15 for Array #5 or Array #13

MINOR FRAMES 26-27

Same pattern as minor frames 14-15 for Array #6 or Array #14

MINOR FRAMES 28-29

Same pattern as minor frames 14-15 for Array #7 or Array #15

3.1.1   ADDITIONAL TELEMETRY INFORMATION

Further explanation of the telemetry data is contained on the
12JAN93 version of the PASP-Plus Telemetry Allocations document.

POWER BYTE (Byte 112):
The byte gives the on/off status of each PASP-Plus instrument (a
1 bit indicates 'on', a 0 bit indicates 'off'). Bit 7 is the
most significant bit of the power byte.

Bit 7   ESA
Bit 6   Emitter
Bit 5   TPM
Bit 4   QCM#2 Heater   (QCM#2=PS)
Bit 3   QCM#2 Osc
Bit 2   QCM#1 Heater   (QCM#1=DPP)
Bit 1   QCM#1 Osc
Bit 0   Langmuir Probe

COMMAND ECHO (Bytes 114-115):

Contains the command most recently received by the PASP-Plus
controller. A command value of 'FFFF' (hex) indicates an invalid
or unrecognized command was received. (29JUL92 NOTE:
Unfortunately, 'FFFF' is also a valid variation of the 'Bias
Load' command, which would also return an echo of 'FFFF'.
Although this command is unlikely to be sent, care should be
taken to differentiate between the two).

TPM (Bytes 116-159):

The TPM data consists of two groups of 22 bytes. The least
significant bit of the first byte of each group defines TPM
packet format. If the least significant bit is zero, the data is
in the 'first packet' format; if the bit is one, the data is in
the 'second packet' format.

HOUSEKEEPING (Bytes 160-163):

Byte 160:	A/D offset (2.422 mV / count). This value (in counts) must be subtracted from ALL ANALOGS before they are converted to engineering units. It should be subtracted directly from 12 bit analogs, but it must be divided by 16 before being subtracted from 8 bit analogs.
Byte 161+MS 4 bits of 162:	Subcommutated housekeeping analog.
LS 4 bits of 162+Byte 163:	HV Bias (measured value) (Voltage=122.1mV/count)

Subcommutated housekeeping analogs:

Minor Frame	Description	Calibration
0-4	None	
5	+28V MON	V=CTS*0.01367
6	+15V MON	V=CTS*0.007287
7	+5V MON	V=CTS*0.002442
8	-15V MON	V=CTS*0.01222-40.03
9	-5V MON	V=CTS*0.007319-19.97
10	ESA LV MON	V=CTS*0.001233
11	ESA HV MON (see note 1)	V=CTS*0.001233
12	Sun Sensor+10V MON	V=CTS*0.001233
13	RTD Ref	V=CTS*0.002442
14	28V Return	(See Note 2)
15	QCM1 Temp	(See Note 3)
16	QCM2 Temp	(See Note 3)
17	CAL1 Temp	(See Note 3)
18	CAL2 Temp	(See Note 3)
19	CAL3 Temp	(See Note 3)
20	0° RTD	(See Note 3)
21	None	
22	Controller Temp	(See Note 3)
23	ESA Temp	(See Note 4)
24	Langmuir Temp	(See Note 5)
24	Emitter Temp	(See Note 6)
25-29	None	

Note:

1. The ESA HV MON values for the 10 ESA channels are sub-
    subcommutated as a function of the 4 LSBs of the Major Frame
    Counter as shown below:

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MF(mod 16)	HVMON	MF(mod 16)	HVMON
0	Energy1	8	Energy9
1	Energy2	9	Energy10
2	Energy3	10	N/A
3	Energy4	11	N/A
4	Energy5	12	N/A
5	Energy6	13	N/A
6	Energy7	14	N/A
7	Energy8	15	N/A

2. This is the measurement of the voltage drop in the 28V return, which is a function of the cable resistance between the BCR and the Controller and the current load of the Controller (which is a function of which PASP+ subsystems are powered)

3. RTDs are converted from counts to °C by:

$$T = CTS * 0.09784 + 472.756 * RTDREF - 256.410,$$
$$\text{where RTDREF is in volts.}$$

4. ESA Temperature is given by:

$$T = 1/A - 273.9$$

where

$$A = .00335 + (1/3891) * \ln(\{5/[.001233 * CTS]\} - 1).$$

5. Langmuir Temperature is given by:

$$T = 1/B - 273.15$$

where

$$B = .0010295 + .0002391 * \ln R + (1.568E\text{-}7) * (\ln R)^3$$

and

$$R = 10^4 * (\{5/[.001233 * CTS]\} - 1)^{-1}.$$

6. Emitter Temperature is given by:

$$T = 74.247 - .0446 * CTS + 1.421 * 10^{-5} * CTS^2 - 2.952 * 10^{-9} * CTS^3 + 1.641 * 10^{-13} * CTS^4$$

CONTROLLER STATUS (Bytes 164-165):

Byte 164   Status of array relays for current minor frame
      Bit 7:   1=positive bias, 0=negative bias
      Bit 6:   1=IV mode, 0=bias mode
      Bit 5:   1=short; 0=no short
      Bit 4:   1=no load, 0=optimum load
      Bit 3-0: Array number of array currently on array bus

```
Byte 165   Bit 7:     Spare
           Bit 6:     1=command received on current minor frame
           Bit 5:     1='Continuous IV' in progress.
           Bit 4:     1='Update all IVs' in progress
           Bit 3:     0=Normal bias; 1=HV reset occurred during
                      most recent bias step.
           Bit 2:     0=Normal mF request; 1=late mF request
                      (timeout)
           Bit 1      0=TPM responding, 1=not responding
           Bit 0:     0=sun in view, 1=sun not in view
```

EMITTER (Bytes 166-171):

The emitter data block contains six 8 bit analogs in the following order: A/B monitor, LV monitor, Emission monitor, BIAS monitor, Heater monitor, and GRID current monitor. Note that the A/D offset (byte 160) must be divided by 16 before correcting the counts. The emitter monitors readout in a particular minor frame were sampled during the previous frame. The conversion factors are:

```
A/B Mon          'A'>146 counts>'B' (actually a bilevel)
LV Mon           19.8 mV/count
Emission Mon     105.32uA/count
Bias Mon         574mV/count
Heater Mon       29.7mA/count
Grid Mon         79.2 nA/count
```

SUN SENSOR (Bytes 172-175):

The sun sensor is sampled twice per second. The format is Axis A, Axis B for the first sample followed by Axis A, Axis B for the second sample. The values are in Gray code and must be converted to decimal before using known formulae (from sun sensor documentation) to calculate the solar aspect angles.

ESA (Bytes 176-255):

The ESA data consists of 10 sets of counts corresponding to energies 1-10. Each set consists of four 16 bit counts in the order ION-HI MSB, ION-HI LSB, ION-LO MSB, ION-LO LSB, ELEC-LO MSB, ELEC-LO LSB, ELEC-HI MSB, ELEC-HI LSB. The accumulation period for all counts is 25/256 sec. All ESA data in a given minor frame was accumulated during the previous minor frame.

QCM Frequency (bytes 8-11, minor frame 1):
The frequency for DP QCM is derived from byte 8 (MS byte) and byte 9 (LS byte). The frequency for PS QCM is derived from byte 10 (MS byte) and byte 11 (LS byte). The conversion factor is

1.067 Hz/count. **Note that because these are not analogs, the A/D offset should not be subtracted from them.**

$$Frequency = 1.067/COUNT$$

Electrometer (bytes 8-15, minor frames 7-29):
The Electrometer is sampled during minor frames 6-28 and telemetered one minor frame after it is sampled (minor frames 7-29. The data set consists of five 12 bit electrometer samples. The 12 bit data is stored contiguously in bytes 8-15. Note that this results in the 4 LSBs of word 15 being vacant. The least significant bit of each 12 bit sample indicates the range of the data in the 11 high order bits. If the LSB is 0, the conversion is 200nA/count for the remaining 11 bits; if it is 1, the conversion is 9.77uA/count. Note that because this is a range indicator, the A/D offset should be divided by 2 before subtracting from the remaining 11 bits. The electrometer data is only updated when the bias is active (bit 7 of byte 111 on minor frame 6 is set to 1).

Langmuir Probe (bytes 16-87 of minor frames 1-8):
The Langmuir Probe is operated during minor frames 0-3. The electron density measurement (Ne) is 8 bit data and is sampled 128/sec; the bias measurement is 8 bit data sampled at 16/second. Samples 0-63 of Ne taken during minor frame 0 appear in bytes 16-79 of minor frame 1; samples 64-127 appear in bytes 16-79 of minor frame 2. Bias data sampled on minor frame 0 is readout in bytes 80-87 of minor frame 1 and minor frame 2. Data sampled on minor frame 1 is readout on minor frame 3 and minor frame 4. Data sampled on minor frame 2 is readout on minor frame 5 and minor frame 6. Data sampled on minor frame 3 is readout on minor frame 7 and minor frame 8. The conversion factor for Ne and Bias is 19.8mV/COUNT. Note that A/D offset (byte 160) must be divided by 16 before converting the counts.

Bias Status (bytes 105-111 of minor frame 6):

If byte 111 has the value 0, then bias is not active, and bytes 105-111 are not applicable and need not be used. Otherwise:
Bytes 105-108: Diagnostic (test flags)
Byte 109:   Current HV **setting** (1.96V/count)
Byte 110:   Bit 7:   1=positive; 0=negative
               Bit 6:   n/a
               Bit 5:   1=short; 0=no short
               Bit 4:   1=no load; 0=optimum load
               Bit 3-0: Array #
Byte 111:   Bit 7:   1=bias active; 0=not active
               Bit 6:   n/a
               Bit 5:   1=pos; 0=neg (same as byte 100, bit 7)
               Bits 4-2: Bias sequence number
               Bits 1-0: Bias step number

Array RTDs (bytes 16-41 of minor frame 9):
All array RTDs are sampled periodically throughout a major frame
such that the time between samples of a specific RTD is 30
seconds (one major frame). The data is 12 bit and stored in
adjacent bytes, e.g. RTD 1 is contained in bytes 16-17 (the 4
most significant bits of byte 16 are zero). The order of readout
for the RTDs is 1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 14, 13, and 15.
Thus, the RTD data is contained in bytes 16-41. The array RTDs
are converted to degrees (C) by:

$$T = 0.09784*COUNTS + 472.756*RTDREF - 256.410,$$
$$\text{where RTDREF is in volts.}$$

Array Data (word locations for the extra IV curve are bytes 16-111 of minor frames 10 and 11; word locations for the remaining IV curves are bytes 16-111 of minor frames 14 through 29):
An IV curve for one array is telemetered once per major frame; 8
minutes are required for the IV curves for all arrays to be
completely updated. Arrays 0-7 are sampled on even major frames;
8-15 on odd major frames. The cycle repeats starting at major
frame multiples of 16. These are called background IVs because
this scheme operates continuously, independent of operating mode.
The table below summarizes the major frame / array sampled
relationship:

LS 4 bits of Major Frame	Array Sampled (updated)
0	0
1	8
2	1
3	9
4	2
5	10
6	3
7	11
8	4
9	12
10	5
11	13
12	6
13	14
14	7
15	15

In addition, there is a telemetry slot reserved for an extra IV,
which is used for several purposes. When biasing, an IV is taken
on the biased array just before each bias step (i.e. once per
major frame). Because a specific IV in the above scheme only
gets downlinked every other major frame, the IV for the biased
array is telemetered as the extra IV, independent of the above
scheme. Also, since the entire IV block is used during
continuous IVs, the scheduled background IV is downlinked in the
extra IV word locations and the above table indicates the array
from which the background IV was taken.

Array RTD, Voc, Isc Measurements   bytes 16-105 of minor frames 12-13):

Minor frame 12 contains data from arrays 0-7 and the extra IV while minor frame 13 contains data from arrays 8-15. Each RTD in this set is taken immediately prior to an IV curve being taken on the respective array. The data is 12 bit (stored in 2 bytes with the 4 MSBs of the first byte set to zero) and the format starting at byte 16 of minor frame 12 is: RTD(0), Isc(0), Vsc(0), Ioc(0), and Voc(0). This pattern repeats for arrays 1-7 and the extra IV, and starts with array 8 on minor frame 13. There are two different sets of calibrations depending on the array number.

For arrays 0, 1, 2, 5, 7, 9, 10, and 14:
    8.547 mV / count and 139.5 µA/count.

For arrays 3, 4, 6, 8, 11, 12, 13, and 15:
    1.214 mV / count and 679.8 µA/count..

The RTDs are converted to degrees centigrade by:

$$T = 0.09784 * counts + 472.756*RTDREF - 256.410,$$
    where RTDREF is in volts.

The analog offset should NOT be subtracted from any of the array current measurements. A more accurate way to correct current measurements is to subtract the value of Ioc measured for each array instead of the analog offset. (The measured Ioc will be the sum of the analog offset plus any offsets in the current measuring circuit).

Not every array has its own RTD. The table below shows which RTD is sampled for each of the arrays:

Array #	Associated RTD
0	RTD1
1	RTD1
2	RTD1
3	RTD3
4	RTD6
5	RTD5
6	RTD6
7	RTD7
8	RTD8
9	RTD9
10	RTD10
11	RTD11
12	RTD12
13	RTD12
14	RTD14
15	RTD13

Array IV curves (bytes 16-111 of minor frames 14-29):

Each IV curve consists of 64 pairs of 12 bit current and 12 bit voltage measurements. The curves are sampled such that point 0 is near Isc and point 63 is near Voc. IV curves for arrays 0-7 are sent on even major frames; the curves for arrays 8-15 are sent on odd major frames. Points 0-31 of IV curve #0 are sent on minor frame 14; points 32-63 are sent on minor frame 15; points 0-31 of IV curve #1 are sent on minor frame 16, etc. For each point, the first byte represents the most significant bits of voltage, bits 7-4 of the second byte are the 4 LSBs of voltage; bit 3-0 of the second byte are the MSBs of current, and byte 3 is the LSB of current.

The extra IV is in the same format as above, except that it occurs on minor frames 10-11, with the array RTD, Voc, and Isc measurements in bytes 96-105 of minor frame 12. It is only valid during biasing, or while a continuous IV is being taken.

When a continuous IV is being taken, the above format applies except that all 16 IVs are taken on the array selected for continuous IVs. The array selected can be determined from bits within controller status byte 164. The background IVs are subcommutated into the extra IV word locations. When a continuous IV is selected, an IV is taken on the selected array during minor frames 7, 10, 13, 16, 19, 22, 25, and 28. The selected array is downlinked in all IV word locations except those for the 'extra IV'.

There are two different sets of calibrations which are array dependent.

For arrays 0, 1, 2, 5, 7, 10, and 14:

$$8.547 \text{ mV / count and } 139.5 \text{ µA/count.}$$

For arrays 3, 4, 6, 8, 11, 12, 13, and 15:

$$1.214 \text{ mV / count and } 679.8 \text{ µA/count.}$$

The voltage values are first converted to mV and then an additional correction is added which involves the resistance for an individual array and the current value associated with the voltage. The formula for voltage `i' of the 66 values is thus:

$$V_i = V_i + I_i * R_j$$

where R_j is the resistance for an individual array. The table of resistances is as follows:

ARRAY NUMBER	RESISTANCE (OHMS)
0	.116
1	.113
2	.114
3	.073
4	.106
5	.130
6	.105
7	.101
8	.115
9	.091
10	.100
11	.109
12	.102
13	.097
14	.100
15	.121

APPENDIX A

Spacecraft State of Health Data from APEX Telemetry list (Version 1.12)

H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
Header - Minor Frame 0											
	Frame Synch	32	1	4	0					Table	
	Frame ID	8	5	5	0					Table	
	Format ID	8	6	6	0					Table	
PSM	Vehicle Time	32	7	10	0	Seconds		0	D	decimal	
	Spare 11	3	11	11	5				D		
PSM	Que Size	3	11	11	2				D	Decimal	
PSM	Que Offset	10	11	12	0	Milsec			D	Decimal	
ACS Telemetry Points											
SCM	ACS Clock Offset	4	13	13	4				P	100	0
SCM	ACS Subsys Error Count	3	13	13	1	Nit			D	decimal	
ACS	ACS Packet Status	1	13	13	0	Y/N			B	0=Valid	1=Miss
ACE	Mom. Wheel Speed	16	14	15	0	RPM	6000	-6000	P	0.1831	-6000
ACE	Mom. Wheel Voltage	16	16	17	0	Volt	65	-65	P	0.001	0
ACE	Mom. Wheel Torque	16	18	19	0	N-m	0.035	-0.035	P	0.00000107	-0.035
ACE	Mom Wheel Brake Torque	8	20	20	0	N-m	0.035	0	P	0.00014	0
ACE	Tor. Rod #1 Curr	8	21	21	0	Amp	0.15	0	P	0.0006	0
ACE	Tor. Rod #1 Dipole	16	22	23	0	Am^2	35	-35	P	0.001068	-35
ACE	Tor. Rod #2 Curr	8	24	24	0	Amp	0.15	0	P	0.0006	0
ACE	Tor. Rod #2 Dipole	16	25	26	0	Am^2	35	-35	P	0.001068	-35
ACE	Tor. Rod #3 Curr	8	27	27	0	Amp	0.15	0	P	0.0006	0
ACE	Tor. Rod #3 Dipole	16	28	29	0	Am^2	35	-35	P	0.001068	-35
ACE	Sun Sensor Angle 1 (X)	16	30	31	0	Deg	64	-64	P	0.00196	-64
ACE	Sun Sensor Angle 2 (Y)	16	32	33	0	Deg	64	-64	P	0.00196	-64
ACE	Spare 34	8	34	34	0						
ACE	Magnetometer #1	16	35	36	0	nT	70000	-70000	P	2.136	-70000
ACE	Magnetometer #2	16	37	38	0	nT	70000	-70000	P	2.136	-70000
ACE	Magnetometer #3	16	39	40	0	nT	70000	-70000	P	2.136	-70000
ACE	Magnetometer #4	16	41	42	0	nT	70000	-70000	P	2.136	-70000
ACE	Mom. Wheel Current	16	43	44	0	Amp	10	0	P	0.001	0
ACE	ACE Execution Code Source	8	45	45	0	Hex			H		
ACE	Spare 46	8	46	46	0						
ACE	Spare 47	2	47	47	6						
ACE	ACE Momentum Wheel	1	47	47	5	Y/N			B	0=Pass	1=Fail
ACE	ACE Torque Rod Driver	1	47	47	4	Y/N			B	0=Pass	1=Fail
ACE	ACE Data I/O	1	47	47	3	Y/N			B	0=Pass	1=Fail
ACE	ACE Power Supply 1	1	47	47	2	Y/N			B	0=Pass	1=Fail
ACE	ACE Power Supply 0	1	47	47	1	Y/N			B	0=Pass	1=Fail
ACE	ACE Cpu	1	47	47	0	Y/N			B	0=Pass	1=Fail
ACE	Spare 48	32	48	51	0						
ACE	ACE Power Supply A Pos. 5 Vdc	8	52	52	0	Volt	14	0	P	0.039	0
ACE	ACE Power Supply A Pos. 12 Vdc	8	53	53	0	Volt	24	0	P	0.0919	0
ACE	ACE Power Supply B Pos. 5 Vdc	8	54	54	0	Volt	14	0	P	0.039	0
ACE	ACE Power Supply B Pos. 12 Vdc	8	55	55	0	Volt	24	0	P	0.0919	0
ACE	Spare 56	8	56	56	0						
ACE	Torq Rod Drv Ref Volt	8	57	57	0	Volt	5	0	P	0.039	0
ACE	Mom Wh Drv Ref Volt	8	58	58	0	Volt	5	0	P	0.039	0
ACE	Sun Sensor State	1	59	59	7	Y/N			B	0=Off	1=Online
ACE	Sun Sensor Power Up Diagnostics	1	59	59	6	Y/N			B	0=Failed	1=Passed
ACE	Sun Sensor Online Diagnostics	1	59	59	5	Y/N			B	0=Failed	1=Passed
ACE	Sun Sensor Status	1	59	59	4	Y/N			B	0=Not Op	1=Funct
ACE	Spare 59	3	59	59	1						
ACE	Sun Sensor Power Supply	1	59	59	0	Y/N			B	0=Out Spc	1=In Spec

H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
ACE	Spare 60	8	60	60	0						
ACE	Sun Presence 1 (X)	1	61	61	7	Y/N			B	0=No Sun	1=Sun
ACE	Sun Presence 2(Y)	1	61	61	6	Y/N			B	0=No Sun	1=Sun
ACE	Spare 61	6	61	61	0						
ACE	Spare 62	7	62	62	1						
ACE	ACS Mode	1	62	62	0	Y/N			B	0=Int/Safe	1=Nom
ACE	ACS Initialization/Safing Module	8	63	63	0	Hex			H		
ACE	Spare 64	7	64	64	1						
ACE	ACS Hold Safing Mode Flag	1	64	64	0	Y/N			B	0=Nom	1=Ovride
ACE	Spare 65	7	65	65	1						
ACE	ACS Hold Coarse Aquisition Flag	1	65	65	0	Y/N			B	0=Nom	1=Ovride
ACE	Spare 66	3	66	66	5						
ACE	X Torque Rod Enable	1	66	66	4	Y/N			B	0=Disbl	1=Enbl
ACE	Y Torque Rod Enable	1	66	66	3	Y/N			B	0=Disbl	1=Enbl
ACE	Z Torque Rod Enable	1	66	66	2	Y/N			B	0=Disbl	1=Enbl
ACE	Momentum Wh Enabled	1	66	66	1	Y/N			B	0=Disbl	1=Enbl
ACE	ACE Safe Hold Status	1	66	66	0	Y/N			B	0=Nom	1=SafeH
SCM	Yaw Commanded	16	67	68	0	Deg	180	-180	P	0.00549	-180
SCM	Pitch Commanded	16	69	70	0	Deg	180	-180	P	0.00549	-180
SCM	Roll Commanded	16	71	72	0	Deg	180	-180	P	0.00549	-180
SCM	Yaw Computed	16	73	74	0	Deg	180	-180	P	0.00549	-180
SCM	Pitch Computed	16	75	76	0	Deg	180	-180	P	0.00549	-180
SCM	Roll Computed	16	77	78	0	Deg	180	-180	P	0.00549	-180
SCM	Yaw Error	16	79	80	0	Deg	180	-180	P	0.00549	-180
SCM	Pitch Error	16	81	82	0	Deg	180	-180	P	0.00549	-180
SCM	Roll Error	16	83	84	0	Deg	180	-180	P	0.00549	-180
SCM	Mom. Wheel Rate Comm.	16	85	86	0	RPM	6000	-6000	P	0.1831	-6000
SCM	Spare 87	16	87	88	0						
SCM	X-Comm. Mag. Torque	16	89	90	0	Am^2	35	-35	P	0.001068	-35
SCM	Y-Comm. Mag. Torque	16	91	92	0	Am^2	35	-35	P	0.001068	-35
SCM	Z-Comm. Mag. Torque	16	93	94	0	Am^2	35	-35	P	0.001068	-35
SCM	Comm. Mom. Wh. Torque	16	95	96	0	Am^2	0.035	-0.035	P	1.07E-06	-0.035
SCM	Greenwich Sidereal Time	16	97	98	0	Deg	180	-180	P	0.00549	-180
SCM	Psi Earth	16	99	100	0	Deg	180	-180	P	0.00549	-180
SCM	ECI X Position (Comp)	32	101	104	0	Meter	1E+08	-1E+08	P	0.04658	-1.00E+08
SCM	ECI Y Position (Comp)	32	105	108	0	Meter	1E+08	-1E+08	P	0.04658	-1.00E+08
SCM	ECI Z Position (Comp)	32	109	112	0	Meter	1E+08	-1E+08	P	0.04658	-1.00E+08
SCM	Roll Rate (Comp)	16	113	114	0	Deg/S	20	-20	P	6.10E-04	-20
SCM	Pitch Rate (Comp)	16	115	116	0	Deg/S	20	-20	P	6.10E-04	-20
SCM	Yaw Rate (Comp)	16	117	118	0	Deg/S	20	-20	P	6.10E-04	-20
SCM	ECI X Velocity (Comp)	32	119	122	0	M/S	1E+05	-1E+05	P	4.65658E-05	-1.00E+05
SCM	ECI Y Velocity (Comp)	32	123	126	0	M/S	1E+05	-1E+05	P	4.65658E-05	-1.00E+05
SCM	ECI Z Velocity (Comp)	32	127	130	0	M/S	1E+05	-1E+05	P	4.65658E-05	-1.00E+05
SCM	Spare 131	16	131	132	0						
SCM	Sun Sensor Data Time Tag	32	133	136	0	Millisec			D	Decimal	
SCM	Magnetometer Data Time Tag	32	137	140	0	Millisec		0	D	Decimal	
SCM	Spare 141	40	141	145	0						
ACS Timer Task Telemetry Points											
SCM	ACS Clock Offset	4	146	146	4				P	100	0
SCM	ACS Subsys Error Count	3	146	146	1	Int			D	decimal	
SCM	ACS Packet Status	1	146	146	0	Y/N			B	0=Valid	1=Miss
SCM	Spare 147	16	147	148	0	Int			D	decimal	
SCM One PPS Driver											
SCM	Spare 149	4	149	149	4						
SCM	SCM OPPS Subsys Error Count	3	149	149	1	Int			D	decimal	
SCM	SCM OPPS Driver Packet Status	1	149	149	0	Y/N			B	0=Valid	1=Miss

H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
SCM	GPS to SCM Pulse Count	6	150	150	2	Int			D	decimal	
SCM	Good GPS Data Sync	1	150	150	1	Y/N			B	0=Sync	1=Masked
SCM	Driver Enabled	1	150	150	0	Y/N			B	0=Enabled	1=Disabled
SCM	SCM Clock Delta mSec	16	151	152	0	mSec			D		
SCM	SCM Clock Current mSec	16	153	154	0	mSec			D		
SCM	Current Time MSW	16	155	156	0						
SCM H&M Telemetry Points											
SCM	SCM H&M Clock Offset	4	157	157	4				P	100	0
SCM	SCM H&M App Error Count	3	157	157	1	Int			D	decimal	
SCM	SCM H&M Packet Status	1	157	157	0	Y/N			B	0=Valid	1=Miss
SCM	SCM Single Bit ErrCount	8	158	158	0	Int			D	Decimal	
SCM	SCM EDAC Error Register	8	159	159	0	Int			D	Decimal	
SCM	Idle Time	8	160	160	0	Percent			P	0.391	0
SCM	Memory Wash Percent Complete	4	161	161	4	Percent			P	6.25	0
SCM	Log Error Flag	1	161	161	3	Y/N			B	0=No Error	1= Error
SCM	Get Error Flag	1	161	161	2	Y/N			B	0=No Error	1= Error
SCM	Zero Free Flag	1	161	161	1	Y/N			B	0=No Error	1= Error
SCM	Zero Receive Flag	1	161	161	0	Y/N			B	0=No Error	1= Error
SCM	Not Found Flag	1	162	162	7	Y/N			B	0=No Error	1= Error
SCM	Zero Send Flag	1	162	162	6	Y/N			B	0=No Error	1= Error
SCM	Send Receive Flag	1	162	162	5	Y/N			B	0=No Error	1= Error
SCM	Get Free Flag	1	162	162	4	Y/N			B	0=No Error	1= Error
SCM	Bad Index Flag	1	162	162	3	Y/N			B	0=No Error	1= Error
SCM	Bad Address Flag	1	162	162	2	Y/N			B	0=No Error	1= Error
SCM	Buffer Table Full Flag	1	162	162	1	Y/N			B	0=No Error	1= Error
SCM	Buffers In Use	9	162	163	0	Int			D	decimal	
SCM	Ping Timer	5	164	164	3	Int			D	decimal	
SCM	Spare 164	11	164	165	0						
SCM	Ready For RAM Download	1	166	166	7	Y/N				0=Not Ready	1=Ready
SCM	Ready For EEPROM Download	1	166	166	6	Y/N				0=Not Ready	1=Ready
SCM	RAM Code Checksum Flag	1	166	166	5	Y/N			D	0=Pass	1=Fail
SCM	EEPROM Code Checksum Flag	1	166	166	4	Y/N			D	0=Pass	1=Fail
SCM	Spare 166B	4	166	166	0						
SCM	Spare 167	8	167	167	0						
SCM	SCM Clock Delta Seconds	16	168	169	0	Seconds			D	Signed Int Decimal	
SCM	Current Time LSW	16	170	171	0						
SCM	Download Base Address	8	172	172	0	Int			P	65536	0
SCM	SCM Clock Resync Count	2	173	173	6	Int			D	Decimal	
SCM	Spare 173	4	173	173	2						
SCM	Contingency Flag	1	173	173	1	Y/N			B	0=Nom	1=Cont
SCM	GPS Clock Sync	1	173	173	0	Y/N			B	0=GPS	1=Free
PSM One PPS Driver											
PSM	Spare 174	4	174	174	4						
PSM	PSM OPPS Subsys Error Count	3	174	174	1	Int			D	decimal	
PSM	PSM OPPS Driver Packet Status	1	174	174	0	Y/N			B	0=Valid	1=Miss
PSM	SCM to PSM Pulse Count	6	175	175	2	Int			D	decimal	
PSM	Good SCM Data Sync	1	175	175	1					0=Sync	1=Masked
PSM	Driver Enabled	1	175	175	0	Y/N			B	0=Enabled	1=Disabled
PSM	PSM Clock Delta mSec	16	176	177	0	mSec			D		
PSM	PSM Clock Current mSec	16	178	179	0	mSec			D		
PSM	Current Time MSW	16	180	181	0						
PSM H&M Telemetry Points											
PSM	PSM H&M Clock Offset	4	182	182	4				P	100	0
PSM	PSM H&M Appl Error Count	3	182	182	1	Int			D	decimal	
PSM	PSM H&M Packet Status	1	182	182	0	Y/N			B	0=Valid	1=Miss
PSM	PSM Single Bit ErrCount	8	183	183	0	Int			D	Decimal	
PSM	PSM EDAC Error Register	8	184	184	0	Int			D	Decimal	

H/W System	Telemetry Point	Bit Len	Byte Range Start	Byte Range End	Bit Offset	IEEE Units	HI	LO	Type	Conversion Slope	Intercept
PSM	Idle Time	8	185	185	0						
PSM	Memory Wash Percent Complete	4	186	186	4	Percent			P	6.25	0
PSM	Log Error Flag	1	186	186	3	Y/N			B	0=No Error	1= Error
PSM	Get Error Flag	1	186	186	2	Y/N			B	0=No Error	1= Error
PSM	Zero Free Flag	1	186	186	1	Y/N			B	0=No Error	1= Error
PSM	Zero Receive Flag	1	186	186	0	Y/N			B	0=No Error	1= Error
PSM	Not Found Flag	1	187	187	7	Y/N			B	0=No Error	1= Error
PSM	Zero Send Flag	1	187	187	6	Y/N			B	0=No Error	1= Error
PSM	Send Receive Flag	1	187	187	5	Y/N			B	0=No Error	1= Error
PSM	Get Free Flag	1	187	187	4	Y/N			B	0=No Error	1= Error
PSM	Bad Index Flag	1	187	187	3	Y/N			B	0=No Error	1= Error
PSM	Bad Address Flag	1	187	187	2	Y/N			B	0=No Error	1= Error
PSM	Buffer Table Full Flag	1	187	187	1	Y/N			B	0=No Error	1= Error
PSM	Buffers In Use	9	187	188	0	Int			D	decimal	
PSM	Ping Timer	5	189	189	3	Int			D	decimal	
PSM	Spare 189	3	189	189	0						
PSM	S/C Computer PS Status	8	190	190	0	Hex			H	hex	
PSM	Ready For RAM Download	1	191	191	7	Y/N				0=Not Ready	1=Ready
PSM	Ready For EEPROM Download	1	191	191	6	Y/N				0=Not Ready	1=Ready
PSM	RAM Code Checksum Flag	1	191	191	5	Y/N			B	0=Pass	1=Fail
PSM	EEPROM Code Checksum Flag	1	191	191	4	Y/N			B	0=Pass	1=Fail
PSM	Spare 191B	4	191	191	0						
PSM	CSTC Application Status	1	192	192	7	Y/N			B	0=Pass	1=Fail
PSM	Sequencer App Status	1	192	192	6	Y/N			B	0=Pass	1=Fail
PSM	ACS Application Status	1	192	192	5	Y/N			B	0=Pass	1=Fail
PSM	GPS Driver App Status	1	192	192	4	Y/N			B	0=Pass	1=Fail
PSM	Pegasus Int App Status	1	192	192	3	Y/N			B	0=Pass	1=Fail
PSM	CRUX Int App Status	1	192	192	2	Y/N			B	0=Pass	1=Fail
PSM	FERRO Int App Status	1	192	192	1	Y/N			B	0=Pass	1=Fail
PSM	PASP-Plus Int App Status	1	192	192	0	Y/N			B	0=Pass	1=Fail
PSM	Dosimeter Int App Status	1	193	193	7	Y/N			B	0=Pass	1=Fail
PSM	FF Application Status	1	193	193	6	Y/N			B	0=Pass	1=Fail
PSM	FB Appplication Status	1	193	193	5	Y/N			B	0=Pass	1=Fail
PSM	PSM H&M App Status	1	193	193	4	Y/N			B	0=Pass	1=Fail
PSM	SCM H&M App Status	1	193	193	3	Y/N			B	0=Pass	1=Fail
PSM	Spare 193	1	193	193	2						
PSM	Beacon Mode Flag	1	193	193	1	Y/N			B	0=Nom	1=Beacn
PSM	System Contingency Flag	1	193	193	0	Y/N			B	0=Nom	1=Cont
PSM	System Cont Error Code	16	194	195	0	Hex			H	hex	
PSM	System Cont Error Source	16	196	197	0	Hex			H	hex	
PSM	Message Log Counter	8	198	198	0	Int			D	decimal	
PSM	Beacon Mode Counter	8	199	199	0	Seconds			P	0.25	0
PSM	PSM Clock Delta Seconds	16	200	201	0	Seconds			D	Signed Int Decimal	
PSM	Current Time LSW	16	202	203	0						
PSM	Download Base Address	8	204	204	0				P	65536	0
PSM	Command Log Counter	8	205	205	0	Int			D	decimal	
PSM	PSM Clock Resync Count	2	206	206	6	Int			D	decimal	
PSM	DR Cmd Log Activity Counter	2	206	206	4	Int			D	decimal	
PSM	DR Error Log Activity Counter	2	206	206	2	Int			D	decimal	
PSM	DR Enabled	1	206	206	1	Y/N			B	0=Disabled	1=Enabled
PSM	SCM Clock Sync	1	206	206	0	Y/N			B	0=SCM	1=Free
DR Telemetry Points											
DRE	Spare 207	4	207	207	4						
DRE	DRChannel3ErrorCount	3	207	207	1	Int			D	decimal	
DRE	DR Packet Status	1	207	207	0	Y/N			B	0=Valid	1=Miss
DRE	SRAM SBE	16	208	209	0	Int			D	Decimal	
DRE	SPARE 210	8	210	210	0	Int			D	Decimal	

H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
DRE	DRAM SBE	8	211	211	0	Int			D	Decimal	
DRE	SPARE 212	8	212	212	0	Int			D	Decimal	
DRE	DRAM DBE	8	213	213	0	Int			D	Decimal	
DRE	DRSystemErrorCount	8	214	214	0	Int			D	Decimal	
DRE	DR Power Supply Pos. 5 Vdc	8	215	215	0	Volt	6	0	P	0.0235	0
DRE	Bit Test Result	16	216	217	0	Hex			H	hex	
DRE	Spare 218	8	218	218	2						
DRE	Mapping Status	1	218	218	1	Y/N			B	0=Enbl	1=Disbl
DRE	Active Board	1	218	218	0	Y/N			B	0=A Board	1=B Board
DRE	DR Pwr Supply Pos. 12 Vdc	8	219	219	0	Volt	15	0	P	0.0588	0
DRE	DR Pwr Supply Neg. 12 Vdc	8	220	220	0	Volt	0	-15	P	-0.0588	0
DRE	DR Pwr. Supply Temp	8	221	221	0	Deg C	114	-50	P	0.64	-50
EPS Telemetry Points											
BCR	Spare 222	7	222	222	1						
BCR	BCR Packet Status	1	222	222	0	Y/N			B	0=Valid	1=Miss
BCR	S/A #1 Current	8	223	223	0	Amp	11.11	0	P	0.04357	0
BCR	S/A #1 Temperature	8	224	224	0	Deg C	123.4	-109.1	P	0.912	-109.12
BCR	S/A #2 Current	8	225	225	0	Amp	11.11	0	P	0.04357	0
BCR	S/A #2 Temperature	8	226	226	0	Deg C	123.4	-109.1	P	0.912	-109.12
BCR	S/A #3 Current	8	227	227	0	Amp	11.11	0	P	0.04357	0
BCR	S/A #3 Temperature	8	228	228	0	Deg C	123.4	-109.1	P	0.912	-109.12
BCR	Batt #1 Voltage #1	8	229	229	0	Volt	40.04	0	P	0.157	0
BCR	Batt #1 Charge Current	8	230	230	0	Amp	22.22	0	P	0.08715	0
BCR	Batt #1 Dischg Current	8	231	231	0	Amp	22.22	0	P	0.08715	0
BCR	Batt #1 Pressure #1	8	232	232	0	PSI	592	0	P	2.3233	0
BCR	Batt #1 Pressure #2	8	233	233	0	PSI	571	0	P	2.2408	0
BCR	Batt #1 Temp #1	8	234	234	0	Deg C	61	-37.2	P	-0.385	61
BCR	Batt #1 Temp #2	8	235	235	0	Deg C	61	-37.2	P	-0.385	61
BCR	Batt #2 Voltage #1	8	236	236	0	Volt	40.04	0	P	0.157	0
BCR	Batt #2 Charge Current	8	237	237	0	Amp	22.22	0	P	0.08715	0
BCR	Batt #2 Dischg Current	8	238	238	0	Amp	22.22	0	P	0.08715	0
BCR	Batt #2 Pressure #1	8	239	239	0	PSI	580	0	P	2.2734	0
BCR	Batt #2 Pressure #2	8	240	240	0	PSI	533	0	P	2.0912	0
BCR	Batt #2 Temp #1	8	241	241	0	Deg C	61	-37.2	P	-0.385	61
BCR	Batt #2 Temp #2	8	242	242	0	Deg C	61	-37.2	P	-0.385	61
BCR	Active BCR Input Voltage	8	243	243	0	Volt	79.99	0	P	0.3137	0
BCR	Active BCR Input Current	8	244	244	0	Amp	22.22	0	P	0.08715	0
BCR	Act BCR FET Rail Temp	8	245	245	0	Deg C	95.8	-51.3	P	-0.577	95.8
BCR	Active BCR PWM0 Value	16	246	247	0	Int			D	Decimal	
BCR	Active BCR PWM1 Value	16	248	249	0	Int			D	Decimal	
BCR	Spare 250	1	250	250	7						
BCR	Act BCR ID	1	250	250	6	Y/N			B	0=BCR A	1=BCR B
BCR	Act BCR Power Control Mode	2	250	250	4	Y/N			B	0=Nom	
BCR	Act BCR Batt #2 Charge Mode	2	250	250	2	Y/N			B	0=Eclipse	1=PPT
BCR	Act BCR Batt #1 Charge Mode	2	250	250	0	Y/N			B	0=Eclipse	1=PPT
BCR	Active BCR Total Load	8	251	251	0	Amp	22.22	0	P	0.08715	0
BCR	Pheonix Mode Flag	2	252	252	6	Y/N			B	0=Off	1=Phnx
BCR	Spare 252	6	252	252	0						
BCR	Solar Array Input Voltage	8	253	253	0	Volt	79.99	0	P	0.3137	0
BCR	Act BCR Curnt Sens Temp	8	254	254	0	Deg C	95.8	-51.3	P	-0.577	95.8
BCR	Spare 255	6	255	255	2						
BCR	BCR PWM A Status	1	255	255	1	Y/N			B	0=Off	1=Active
BCR	BCR PWM B Status	1	255	255	0	Y/N			B	0=Off	1=Active
BCR	Max Charge Rate	8	256	256	0	Amp	22.22	0	P	0.08715	0
BCR	Batt 1 Htr 1 Auto/Override	1	257	257	7	Y/N			B	0=Auto	1=Override
BCR	Batt 1 Htr 1 Cmd On/Off	1	257	257	6	Y/N			B	0=Off	1=On

H/W System	Telemetry Point	Bit Len	Byte Range Start	Byte Range End	Bit Offset	IEEE Units	Engineering HI	Engineering LO	Type	Conversion Slope	Intercept
BCR	Batt 1 Htr 1 Sensor 2 Enbl	1	257	257	5	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1 Htr 1 Sensor 1 Enbl	1	257	257	4	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1 Htr 1 Sensor 0 Enbl	1	257	257	3	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1 Htr 1 Sensor 2 Valid	1	257	257	2	Y/N			B	0=Error	1=Valid
BCR	Batt 1 Htr 1 Sensor 1 Valid	1	257	257	1	Y/N			B	0=Error	1=Valid
BCR	Batt 1 Htr 1 Sensor 0 Valid	1	257	257	0	Y/N			B	0=Error	1=Vaillid
BCR	Spare 258	8	258	258	0						
BCR	Batt 2 Htr 1 Auto/Override	1	259	259	7	Y/N			B	0=Auto	1=Override
BCR	Batt 2 Htr 1 Cmd On/Off	1	259	259	6	Y/N			B	0=Off	1=On
BCR	Batt 2 Htr 1 Sensor 2 Enbl	1	259	259	5	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2 Htr 1 Sensor 1 Enbl	1	259	259	4	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2 Htr 1 Sensor 0 Enbl	1	259	259	3	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2 Htr 1 Sensor 2 Valid	1	259	259	2	Y/N			B	0=Error	1=Valid
BCR	Batt 2 Htr 1 Sensor 1 Valid	1	259	259	1	Y/N			B	0=Error	1=Valid
BCR	Batt 2 Htr 1 Sensor 0 Valid	1	259	259	0	Y/N			B	0=Error	1=Vaillid
BCR	Spare 260	8	260	260	0						
BCR	PM Heater Auto/Override	1	261	261	7	Y/N			B	0=Auto	1=Override
BCR	PM Heater Cmd On/Off	1	261	261	6	Y/N			B	0=Off	1=On
BCR	PM Heater Sensor 2 Enbl	1	261	261	5	Y/N			B	0=Disbl	1=Enbl
BCR	PM Heater Sensor 1 Enbl	1	261	261	4	Y/N			B	0=Disbl	1=Enbl
BCR	PM Heater Sensor 0 Enbl	1	261	261	3	Y/N			B	0=Disbl	1=Enbl
BCR	PM Heater Sensor 2 Valid	1	261	261	2	Y/N			B	0=Error	1=Valid
BCR	PM Heater Sensor 1 Valid	1	261	261	1	Y/N			B	0=Error	1=Valid
BCR	PM Heater Sensor 0 Valid	1	261	261	0	Y/N			B	0=Error	1=Vaillid
BCR	Active BCR Stack Pointer	16	262	263	0	Hex			H	Hex	
BCR	LCM Current Sens 1 Temp	8	264	264	0	Deg C	95.8	-51.3	P	-0.577	95.8
BCR	LCM Current Sens 2 Temp	8	265	265	0	Deg C	95.8	-51.3	P	-0.577	95.8
BCR	LCM Current Sens 3 Temp	8	266	266	0	Deg C	95.8	-51.3	P	-0.577	95.8
BCR	LCM Current Sens 4 Temp	8	267	267	0	Deg C	95.8	-51.3	P	-0.577	95.8
BCR	LCM 5V Reference Voltage	8	268	268	0	Volt	10	0	P	0.0392	0
BCR	Main Loop Counter	24	269	271	0	Int			D	decimal	
BCR	Executed Commands Counter	16	272	273	0	Int			D	decimal	
BCR	Spare 274	8	274	274	0						
BCR	Bus Voltage	8	275	275	0	Volt	40.04	0	P	0.157	0
BCR	Spare 276	8	276	276	0						
BCR	All Clear Mess Sent	1	277	277	7	Y/N			B	0=NoMess	1=Clear
BCR	Level 3 Mess Sent	1	277	277	6	Y/N			B	0=Nom	1=Lv3Mess
BCR	Level 2 Mess Sent	1	277	277	5	Y/N			B	0=Nom	1=Lv2Mess
BCR	Level 1 Mess Sent	1	277	277	4	Y/N			B	0=Nom	1=Lv1Mess
BCR	EPS Contingnency Status	1	277	277	3	Y/N			B	0=Nom	1=Cont
BCR	Level 3 Loads Sheded	1	277	277	2	Y/N			B	0=Nom	1=Shed
BCR	Level 2 Loads Sheded	1	277	277	1	Y/N			B	0=Nom	1=Shed
BCR	Level 1 Loads Sheded	1	277	277	0	Y/N			B	0=Nom	1=Shed
BCR	Present DOD	8	278	278	0	Percent	137	-33	P	0.667	-33.33
BCR	Load Shed Priority ACE	2	279	279	6	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority GPS	2	279	279	4	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority DR	2	279	279	2	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority SCC	2	279	279	0	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Spare 280	2	280	280	6						
BCR	Load Shed Priority SGLS Tx	2	280	280	4	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority SGLS Rx	2	280	280	2	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority Spare	2	280	280	0	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority PASP	2	281	281	6	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority Emmiter	2	281	281	4	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority FERRO	2	281	281	2	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority CRUX	2	281	281	0	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Spare 282	2	282	282	6						
BCR	Load Shed Priority HIU Elc	2	282	282	4	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority Dosim	2	282	282	2	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Load Shed Priority HIU Htr	2	282	282	0	Y/N			B	0=Lvl 1	1=Lvl 2
BCR	Present Level 1 Threshhold	8	283	283	0	Percent	137	-33	P	0.667	-33.33

H/W System	Telemetry Point	Bit Len	Byte Range Start	Byte Range End	Bit Offset	IEEE Units	Engineering HI	Engineering LO	Type	Conversion Slope	Intercept
BCR	Present Level 2 Threshhold	8	284	284	0	Percent	137	-33	P	0.667	-33.33
BCR	SCC Mode	2	285	285	6	Y/N			B	0=PROM	1=Commd
BCR	SCC Shtdwn Lim Exceeded	1	285	285	5	Y/N			B	0=Nom	1=Shutd
BCR	SCC Overload Detected	1	285	285	4	Y/N			B	0=Nom	1=Warn
BCR	SCC Overload Paramaters	1	285	285	3	Y/N			B	0=Runtm	1=Start
BCR	SCC Action Status	1	285	285	2	Y/N			B	0=Comp	1=Pend
BCR	SCC Auto	1	285	285	1	Y/N			B	0=Cmd	1=Auto
BCR	SCC On/Off	1	285	285	0	Y/N			B	0=Off	1=On
BCR	SCC Load Current	8	286	286	0	Amps	5.56	0	P	0.02179	0
BCR	DR Mode	2	287	287	6	Y/N			B	0=PROM	1=Commd
BCR	DR Shtdwn Lim Exceeded	1	287	287	5	Y/N			B	0=Nom	1=Shutd
BCR	DR Overload Detected	1	287	287	4	Y/N			B	0=Nom	1=Warn
BCR	DR Overload Paramaters	1	287	287	3	Y/N			B	0=Runtm	1=Start
BCR	DR Action Status	1	287	287	2	Y/N			B	0=Comp	1=Pend
BCR	DR Auto	1	287	287	1	Y/N			B	0=Cmd	1=Auto
BCR	DR On/Off	1	287	287	0	Y/N			B	0=Off	1=On
BCR	DR Load Current	8	288	288	0	Amps	5.56	0	P	0.02179	0
BCR	ACS Mode	2	289	289	6	Y/N			B	0=PROM	1=Commd
BCR	ACS Shtdwn Lim Exceeded	1	289	289	5	Y/N			B	0=Nom	1=Shutd
BCR	ACS Overload Detected	1	289	289	4	Y/N			B	0=Nom	1=Warn
BCR	ACS Overload Paramaters	1	289	289	3	Y/N			B	0=Runtm	1=Start
BCR	ACS Action Status	1	289	289	2	Y/N			B	0=Comp	1=Pend
BCR	ACS Auto	1	289	289	1	Y/N			B	0=Cmd	1=Auto
BCR	ACS On/Off	1	289	289	0	Y/N			B	0=Off	1=On
BCR	ACS Load Current	8	290	290	0	Amps	7.44	0	P	0.02919	0
BCR	HIU Elec Mode	2	291	291	6	Y/N			B	0=PROM	1=Commd
BCR	HIU Elec Shtd Lim Excd	1	291	291	5	Y/N			B	0=Nom	1=Shutd
BCR	HIU Elec Overload Detect	1	291	291	4	Y/N			B	0=Nom	1=Warn
BCR	HIU Elec Overload Params	1	291	291	3	Y/N			B	0=Runtm	1=Start
BCR	HIU Elec Action Status	1	291	291	2	Y/N			B	0=Comp	1=Pend
BCR	HIU Elec Auto	1	291	291	1	Y/N			B	0=Cmd	1=Auto
BCR	HIU Elec On/Off	1	291	291	0	Y/N			B	0=Off	1=On
BCR	HIU Load Current	8	292	292	0	Amps	5.56	0	P	0.02179	0
BCR	HIU Htr Mode	2	293	293	6	Y/N			B	0=PROM	1=Commd
BCR	HIU Htr Shtd Lim Excd	1	293	293	5	Y/N			B	0=Nom	1=Shutd
BCR	HIU Htr Overload Detect	1	293	293	4	Y/N			B	0=Nom	1=Warn
BCR	HIU Htr Overload Params	1	293	293	3	Y/N			B	0=Runtm	1=Start
BCR	HIU Htr Action Status	1	293	293	2	Y/N			B	0=Comp	1=Pend
BCR	HIU Htr Auto	1	293	293	1	Y/N			B	0=Cmd	1=Auto
BCR	HIU Htr On/Off	1	293	293	0	Y/N			B	0=Off	1=On
BCR	HIU Htr Load Current	8	294	294	0	Amps	11.11	0	P	0.04357	0
BCR	SGLS Rx Mode	2	295	295	6	Y/N			B	0=PROM	1=Commd
BCR	SGLS Rx Shtd Lim Exceed	1	295	295	5	Y/N			B	0=Nom	1=Shutd
BCR	SGLS Rx Overload Detect	1	295	295	4	Y/N			B	0=Nom	1=Warn
BCR	SGLS Rx Overload Params	1	295	295	3	Y/N			B	0=Runtm	1=Start
BCR	SGLS Rx Action Status	1	295	295	2	Y/N			B	0=Comp	1=Pend
BCR	SGLS Rx Auto	1	295	295	1	Y/N			B	0=Cmd	1=Auto
BCR	SGLS Rx On/Off	1	295	295	0	Y/N			B	0=Off	1=On
BCR	SGLS Rx Load Current	8	296	296	0	Amps	5.56	0	P	0.02179	0
BCR	SGLS Tx Mode	2	297	297	6	Y/N			B	0=PROM	1=Commd
BCR	SGLS Tx Shtd Lim Exceed	1	297	297	5	Y/N			B	0=Nom	1=Shutd
BCR	SGLS Tx Overload Detect	1	297	297	4	Y/N			B	0=Nom	1=Warn
BCR	SGLS Tx Overload Params	1	297	297	3	Y/N			B	0=Runtm	1=Start
BCR	SGLS Tx Action Status	1	297	297	2	Y/N			B	0=Comp	1=Pend
BCR	SGLS Tx Auto	1	297	297	1	Y/N			B	0=Cmd	1=Auto
BCR	SGLS Tx On/Off	1	297	297	0	Y/N			B	0=Off	1=On

H/W System	Telemetry Point	Bit Len	Byte Range Start	Byte Range End	Bit Offset	IEEE Units	Engineering HI	Engineering LO	Type	Conversion Slope	Intercept
BCR	SGLS Tx Load Current	8	298	298	0	Amps	5.56	0	P	0.02179	0
BCR	Spare Mode	2	299	299	6	Y/N			B	0=PROM	1=Commd
BCR	Spare Shutdwn Lim Exceed	1	299	299	5	Y/N			B	0=Nom	1=Shutd
BCR	Spare Overload Detect	1	299	299	4	Y/N			B	0=Nom	1=Warn
BCR	Spare Overload Params	1	299	299	3	Y/N			B	0=Runtm	1=Start
BCR	Spare Action Status	1	299	299	2	Y/N			B	0=Comp	1=Pend
BCR	Spare Auto	1	299	299	1	Y/N			B	0=Cmd	1=Auto
BCR	Spare On/Off	1	299	299	0	Y/N			B	0=Off	1=On
BCR	Spare Load Current	8	300	300	0	Amps	11.11	0	P	0.04357	0
BCR	Spare 301	16	301	302	0						
BCR	GPS Mode	2	303	303	6	Y/N			B	0=PROM	1=Commd
BCR	GPS Shutdwn Lim Exceed	1	303	303	5	Y/N			B	0=Nom	1=Shutd
BCR	GPS Overload Detect	1	303	303	4	Y/N			B	0=Nom	1=Warn
BCR	GPS Overload Params	1	303	303	3	Y/N			B	0=Runtm	1=Start
BCR	GPS Action Status	1	303	303	2	Y/N			B	0=Comp	1=Pend
BCR	GPS Auto	1	303	303	1	Y/N			B	0=Cmd	1=Auto
BCR	GPS On/Off	1	303	303	0	Y/N			B	0=Off	1=On
BCR	GPS Load Current	8	304	304	0	Amps	5.56	0	P	0.02179	0
BCR	CRUX Mode	2	305	305	6	Y/N			B	0=PROM	1=Commd
BCR	CRUX Shutdwn Lim Exceed	1	305	305	5	Y/N			B	0=Nom	1=Shutd
BCR	CRUX Overload Detect	1	305	305	4	Y/N			B	0=Nom	1=Warn
BCR	CRUX Overload Params	1	305	305	3	Y/N			B	0=Runtm	1=Start
BCR	CRUX Action Status	1	305	305	2	Y/N			B	0=Comp	1=Pend
BCR	CRUX Auto	1	305	305	1	Y/N			B	0=Cmd	1=Auto
BCR	CRUX On/Off	1	305	305	0	Y/N			B	0=Off	1=On
BCR	CRUX Load Current	8	306	306	0	Amps	7.44	0	P	0.02919	0
BCR	FERRO Mode	2	307	307	6	Y/N			B	0=PROM	1=Commd
BCR	FERRO Shutdwn Lim Excd	1	307	307	5	Y/N			B	0=Nom	1=Shutd
BCR	FERRO Overload Detect	1	307	307	4	Y/N			B	0=Nom	1=Warn
BCR	FERRO Overload Params	1	307	307	3	Y/N			B	0=Runtm	1=Start
BCR	FERRO Action Status	1	307	307	2	Y/N			B	0=Comp	1=Pend
BCR	FERRO Auto	1	307	307	1	Y/N			B	0=Cmd	1=Auto
BCR	FERRO On/Off	1	307	307	0	Y/N			B	0=Off	1=On
BCR	FERRO Load Current	8	308	308	0	Amps	7.44	0	P	0.02919	0
BCR	Dosim Mode	2	309	309	6	Y/N			B	0=PROM	1=Commd
BCR	Dosim Shutdwn Lim Excd	1	309	309	5	Y/N			B	0=Nom	1=Shutd
BCR	Dosim Overload Detect	1	309	309	4	Y/N			B	0=Nom	1=Warn
BCR	Dosim Overload Params	1	309	309	3	Y/N			B	0=Runtm	1=Start
BCR	Dosim Action Status	1	309	309	2	Y/N			B	0=Comp	1=Pend
BCR	Dosim Auto	1	309	309	1	Y/N			B	0=Cmd	1=Auto
BCR	Dosim On/Off	1	309	309	0	Y/N			B	0=Off	1=On
BCR	Dosim Load Current	8	310	310	0	Amps	11.11	0	P	0.04357	0
BCR	Emitter Mode	2	311	311	6	Y/N			B	0=PROM	1=Commd
BCR	Emmiter Shutdwn Lim Excd	1	311	311	5	Y/N			B	0=Nom	1=Shutd
BCR	Emitter Overload Detect	1	311	311	4	Y/N			B	0=Nom	1=Warn
BCR	Emitter Overload Params	1	311	311	3	Y/N			B	0=Runtm	1=Start
BCR	Emitter Action Status	1	311	311	2	Y/N			B	0=Comp	1=Pend
BCR	Emitter Auto	1	311	311	1	Y/N			B	0=Cmd	1=Auto
BCR	Emitter On/Off	1	311	311	0	Y/N			B	0=Off	1=On
BCR	Emitter Load Current	8	312	312	0	Amps	11.11	0	P	0.04357	0
BCR	PASP Mode	2	313	313	6	Y/N			B	0=PROM	1=Commd
BCR	PASP Shutdwn Lim Excd	1	313	313	5	Y/N			B	0=Nom	1=Shutd
BCR	PASP Overload Detect	1	313	313	4	Y/N			B	0=Nom	1=Warn
BCR	PASP Overload Params	1	313	313	3	Y/N			B	0=Runtm	1=Start

H/W System	Telemetry Point	Bit Len	Byte Range Start	Byte Range End	Bit Offset	IEEE Units	Engineering HI	Engineering LO	Type	Conversion Slope	Intercept
BCR	PASP Action Status	1	313	313	2	Y/N			B	0=Comp	1=Pend
BCR	PASP Auto	1	313	313	1	Y/N			B	0=Cmd	1=Auto
BCR	PASP On/Off	1	313	313	0	Y/N			B	0=Off	1=On
BCR	PASP Load Current	8	314	314	0	Amps	11.11	0	P	0.04357	0
BCR	Spare 2 Mode	2	315	315	6	Y/N			B	0=PROM	1=Commd
BCR	Spare 2 Shutdwn Lim Exceed	1	315	315	5	Y/N			B	0=Nom	1=Shutd
BCR	Spare 2 Overload Detect	1	315	315	4	Y/N			B	0=Nom	1=Warn
BCR	Spare 2 Overload Params	1	315	315	3	Y/N			B	0=Runtm	1=Start
BCR	Spare 2 Action Status	1	315	315	2	Y/N			B	0=Comp	1=Pend
BCR	Spare 2 Auto	1	315	315	1	Y/N			B	0=Cmd	1=Auto
BCR	Spare 2 On/Off	1	315	315	0	Y/N			B	0=Off	1=On
BCR	Spare 2 Load Current	8	316	316	0	Amps	22.22	0	P	0.08715	0
BCR	Trickle Charge Rate	8	317	317	0	Amp	22.22	0	P	0.08715	0
BCR	Batt 1, Batt 2 Temp Sensor 2 Enbl	1	318	318	7	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1, Batt 2 Temp Sensor 1 Enbl	1	318	318	6	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1, Batt 1 Temp Sensor 2 Enbl	1	318	318	5	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1, Batt 1 Temp Sensor 1 Enbl	1	318	318	4	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1, Batt 2 Pres Sensor 2 Enbl	1	318	318	3	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1, Batt 2 Pres Sensor 1 Enbl	1	318	318	2	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1, Batt 1 Pres Sensor 2 Enbl	1	318	318	1	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1, Batt 1 Pres Sensor 1 Enbl	1	318	318	0	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 1, Batt 2 Temp Sensor 2 Lock	1	319	319	7	Y/N			B	0=Unlock	1=Lock
BCR	Batt 1, Batt 2 Temp Sensor 1 Lock	1	319	319	6	Y/N			B	0=Unlock	1=Lock
BCR	Batt 1, Batt 1 Temp Sensor 2 Lock	1	319	319	5	Y/N			B	0=Unlock	1=Lock
BCR	Batt 1, Batt 1 Temp Sensor 1 Lock	1	319	319	4	Y/N			B	0=Unlock	1=Lock
BCR	Batt 1, Batt 2 Pres Sensor 2 Lock	1	319	319	3	Y/N			B	0=Unlock	1=Lock
BCR	Batt 1, Batt 2 Pres Sensor 1 Lock	1	319	319	2	Y/N			B	0=Unlock	1=Lock
BCR	Batt 1, Batt 1 Pres Sensor 2 Lock	1	319	319	1	Y/N			B	0=Unlock	1=Lock
BCR	Batt 1, Batt 1 Pres Sensor 1 Lock	1	319	319	0	Y/N			B	0=Unlock	1=Lock
BCR	Batt 2, Batt 2 Temp Sensor 2 Enbl	1	320	320	7	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2, Batt 2 Temp Sensor 1 Enbl	1	320	320	6	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2, Batt 1 Temp Sensor 2 Enbl	1	320	320	5	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2, Batt 1 Temp Sensor 1 Enbl	1	320	320	4	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2, Batt 2 Pres Sensor 2 Enbl	1	320	320	3	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2, Batt 2 Pres Sensor 1 Enbl	1	320	320	2	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2, Batt 1 Pres Sensor 2 Enbl	1	320	320	1	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2, Batt 1 Pres Sensor 1 Enbl	1	320	320	0	Y/N			B	0=Disbl	1=Enbl
BCR	Batt 2, Batt 2 Temp Sensor 2 Lock	1	321	321	7	Y/N			B	0=Unlock	1=Lock
BCR	Batt 2, Batt 2 Temp Sensor 1 Lock	1	321	321	6	Y/N			B	0=Unlock	1=Lock
BCR	Batt 2, Batt 1 Temp Sensor 2 Lock	1	321	321	5	Y/N			B	0=Unlock	1=Lock
BCR	Batt 2, Batt 1 Temp Sensor 1 Lock	1	321	321	4	Y/N			B	0=Unlock	1=Lock
BCR	Batt 2, Batt 2 Pres Sensor 2 Lock	1	321	321	3	Y/N			B	0=Unlock	1=Lock
BCR	Batt 2, Batt 2 Pres Sensor 1 Lock	1	321	321	2	Y/N			B	0=Unlock	1=Lock
BCR	Batt 2, Batt 1 Pres Sensor 2 Lock	1	321	321	1	Y/N			B	0=Unlock	1=Lock
BCR	Batt 2, Batt 1 Pres Sensor 1 Lock	1	321	321	0	Y/N			B	0=Unlock	1=Lock
BCR	Battery 1 DOD	8	322	322	0	Percent	137	-33	P	0.667	-33.33
BCR	Battery 2 DOD	8	323	323	0	Percent	137	-33	P	0.667	-33.33
BCR	Battery 1, Full Charge Press Set	8	324	324	0	PSI	500	0	P	1.961	0
BCR	Battery 2, Full Charge Press Set	8	325	325	0	PSI	500	0	P	1.961	0
BCR	Good FCS Packets Recleved	16	326	327	0	Int			D	declmal	
BCR	Bad FCS Packets Recleved	16	328	329	0	Int			D	declmal	
BCR	Commands Rejected (FRK, NAK)	16	330	331	0	Int			D	declmal	
BCR	SGLS Tx Time Till Shutdown	8	332	332	0	Minutes	21.75	0	P	0.0853	0
Spare											
PSM	Spare 333	128	333	348	0						
S/W TLM Points - File Backhauler Application											
PSM	FB Clock Offset	4	349	349	4	Int			P	100	0
PSM	FB App Error Count	3	349	349	1	Int			D	declmal	

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H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
PSM	FB Packet Status	1	349	349	0	Y/N			B	0=Valid	1=Miss
PSM	Current File ID	8	350	350	0	Hex			H	hex	
PSM	Spare 351	1	351	351	7	Y/N			B	0=Nom	1=Late
PSM	Telemetry Rate	1	351	351	6	Y/N			B	0=128k	1=16k
PSM	Spare 351B	2	351	351	4	Y/N			B	0=Currnt	1=NotCrt
PSM	Previous MF0 Late	1	351	351	3	Y/N			B	0=Nom	1=Late
PSM	Previous MF1 Late	1	351	351	2	Y/N			B	0=Nom	1=Late
PSM	Spare 351C	1	351	351	1						
PSM	DR Enabled	1	351	351	0	Y/N			B	0=Disabled	1=Enabled
PSM	Major Frame Drop Count	2	352	352	6	Int			D	Decimal	
PSM	Major Frame Insert Count	2	352	352	4	Int			D	Decimal	
PSM	Ack Received Count	4	352	352	0	Int			D	Decimal	
S/W TPM Points - Frame Formatter Application											
SCM	FF Clock Offset	4	353	353	4	Int			P	100	0
SCM	FF App Error Count	3	353	353	1	Int			D	decimal	
SCM	FF Packet Status	1	353	353	0	Y/N			B	0=Valid	1=Miss
SCM	Contin. SOH State	1	354	354	7	Y/N			B	0=Nom	1=1/sec
SCM	Minor Frame Flag	1	354	354	6	Y/N			B		
SCM	Spare 354	1	354	354	5						
PSM	DR SOH Activity Counter	2	354	354	3	Int			D	decimal	
PSM	DR Cont SOH Activity Counter	2	354	354	1	Int			D	decimal	
PSM	DR Enabled	1	354	354	0	Y/N			B	0=Disabled	1=Enabled
SCM	Major Version Number	4	355	355	4	Int			D	decimal	
SCM	Minor Version Number	4	355	355	0	Int			D	decimal	
SCM	Spare 356	8	356	356	0						
S/W TLM Points - FERRO Interrogator Application											
PSM	FR Clock Offset	4	357	357	4	Int			P	100	0
PSM	FR App Error Count	3	357	357	1	Int			D	decimal	
PSM	FR Packet Status	1	357	357	0	Y/N			B	0=Valid	1=Miss
PSM	Start/Stop Poll Flag	1	358	358	7	Y/N			B	0=Stop	1=Start
PSM	Late Packet Flag	1	358	358	6	Y/N			B	0=Nom	1=Late
PSM	Spare 358	1	358	358	5						
PSM	DR Ferro Activity Counter	2	358	358	3	Int			D	decimal	
PSM	DR Ferro SOH Activity Counter	2	358	358	1	Int			D	decimal	
PSM	DR Enabled	1	358	358	0	Y/N			B	0=Disabled	1=Enabled
PSM	Command Echo Error Count	8	359	359	0	Int			D	decimal	
PSM	Queue Count	8	360	360	0	Int			D	decimal	
PSM	Packet Polled	8	361	361	0	Int			D	decimal	
PSM	Spare 362	8	362	362	0						
S/W TLM Points - PASP-Plus Interrogator Application											
PSM	PP Clock Offset	4	363	363	4	Int			P	100	0
PSM	PP App Error Count	3	363	363	1	Int			D	decimal	
PSM	PP Packet Status	1	363	363	0	Y/N			B	0=Valid	1=Miss
PSM	Start/Stop Poll Flag	1	364	364	7	Y/N			B	0=Stop	1=Start
PSM	Late Packet Flag	1	364	364	6	Y/N			B	0=Nom	1=Late
PSM	Spare 364	3	364	364	3						
PSM	DR PASP Activity Counter	2	364	364	1	Int			D	decimal	
PSM	DR Enabled	1	364	364	0	Y/N			B	0=Disabled	1=Enabled
PSM	Poll Timeout Error Count	8	365	365	0	Int			D	decimal	
PSM	Queue Count	8	366	366	0	Int			D	decimal	
PSM	Spare 367	8	367	367	0						
S/W TLM Points - CRUX/CREDO Interrogator Application											
PSM	CX Clock Offset	4	368	368	4	Int			P	100	0
PSM	CX App Error Count	3	368	368	1	Int			D	decimal	

H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
PSM	CX Packet Status	1	368	368	0	Y/N			B	0=Valid	1=Miss
PSM	Start/Stop Poll Flag	1	369	369	7	Y/N			B	0=Stop	1=Start
PSM	Late Packet Flag	1	369	369	6	Y/N			B	0=Nom	1=Late
PSM	Packet Polled	3	369	369	3	Y/N			D	0=NONE, 1=NULL, 2=Science 1, 3=Science 2, 4=CRUX SOH, 5=CREDO DATA	
PSM	Spare 369	3	369	369	0						
PSM	Command Echo Error Count	8	370	370	0	Int			D	decimal	
PSM	Queue Count	8	371	371	0	Int			D	decimal	
PSM	Poll Cycle Second Count	8	372	372	0	Int			D	decimal	
PSM	Spare 373	1	373	373	7						
PSM	DR Crux Activity Counter	2	373	373	5	Int			D	decimal	
PSM	DR Crux SOH Activity Counter	2	373	373	3	Int			D	decimal	
PSM	DR Credo Activity Counter	2	373	373	1	Int			D	decimal	
PSM	DR Enabled	1	373	373	0	Y/N			B	0=Disabled	1=Enabled
PSM	Spare 374	40	374	378	0						
S/W TLM Points - Dosimeter Interrogator Application											
PSM	DS Clock Offset	4	379	379	4	Int			P	100	0
PSM	DS App Error Count	3	379	379	1	Int			D	decimal	
PSM	DS Packet Status	1	379	379	0	Y/N			B	0=Valid	1=Miss
PSM	Start/Stop Poll Flag	1	380	380	7	Y/N			B	0=Stop	1=Start
PSM	Late Packet Flag	1	380	380	6	Y/N			B	0=Nom	1=Late
PSM	Dosimeter Telemetry Format	1	380	380	5	Y/N			B	0=Norm	1=Housk
PSM	Spare 380	2	380	380	3						
PSM	DR Dosimeter Activity Counter	2	380	380	1	Int			D	decimal	
PSM	DR Enabled	1	380	380	0	Y/N			B	0=Disabled	1=Enabled
PSM	Poll Timeout Error Count	8	381	381	0	Int			D	decimal	
PSM	Queue Count	8	382	382	0	Int			D	decimal	
S/W TLM Points - Pegasus Interface Application											
PSM	Spare 383	4	383	383	4						
PSM	PG App Error Count	3	383	383	1	Int			D	decimal	
PSM	PG Packet Status	1	383	383	0	Y/N			B	0=Valid	1=Miss
SCM	State Vector Count	8	384	384	0	Int			D	decimal	
SCM	TLM Packet Count To PPE	8	385	385	0	Int			D	decimal	
SCM	Check Word Error Count	8	386	386	0	Int			D	decimal	
SCM	Spare 387	32	387	390	0						
S/W TLM Points - CSTC Application											
PSM	CSTC Clock Offset	4	391	391	4	Int			P	100	0
PSM	CSTC App Error Count	3	391	391	1	Int			D	decimal	
PSM	CSTC Packet Status	1	391	391	0	Y/N			B	0=Valid	1=Miss
PSM	Spare 392	8	392	392	0						
PSM	Authentication Count	24	393	395	0	Int			D	decimal	
PSM	Message Count	8	396	396	0	Int			D	decimal	
PSM	Verified Command Count	8	397	397	0	Int			D	decimal	
PSM	Total Command Count	8	398	398	0	Int			D	decimal	
PSM	NOP Count	8	399	399	0	Int			D	decimal	
PSM	SW Load Bytes Received	16	400	401	0	Int			D	decimal	
PSM	Spare 402	4	402	402	4						
PSM	Authentication State	2	402	402	2	Y/N			B	0=Waiting	1=Partial
PSM	Spare 402B	2	402	402	0						
PSM	Time Till No Contact Mode	16	403	404	0	Minutes			D	decimal	
PSM	No Contact Limit	16	405	406	0	Minutes			D	decimal	
PSM	Executed Command Count	8	407	407	0				D	decimal	
PSM	SW Load Destination	16	408	409	0						
PSM	Spare 410	24	410	412	0						

H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
S/W TLM Points - Sequencer Application											
PSM	SE Clock Offset	4	413	413	4	Int			P	100	0
PSM	SE App Error Count	3	413	413	1	Int			D	decimal	
PSM	SE Packet Status	1	413	413	0	Y/N			B	0=Valid	1=Miss
PSM	Next Time Tag Address	16	414	415	0	Int			D	decimal	
PSM	Next Sequencer Address	16	416	417	0	Int			D	decimal	
PSM	Next Macro Address RT	16	418	419	0	Int			D	decimal	
PSM	Current Sequencer State	1	420	420	7	Y/N			B	0=Enabl	1=Disabl
PSM	Sequencer Table Changed	1	420	420	6	Y/N			B	0=Nochg	1=Changed
PSM	Macro Table Changed	1	420	420	5	Y/N			B	0=Nochg	1=Changed
PSM	Spare 420	5	420	420	0						
PSM	Next Macro Address TT	16	421	422	0	Int			D	decimal	
HIU and TT&C Telemetry Points											
HIU	Spare 423	4	423	423	4						
HIU	HIU Subsys Error Count	3	423	423	1	Int			D	decimal	
HIU	HIU Packet Status	1	423	423	0	Y/N			B	0=Valid	1=Miss
HIU	HIU A/D Ground	8	424	424	0	Volt	5	0	P	0.0195	0
HIU	Spare 425	16	425	426	0						
HIU	Temp Cal 1st 7 (-30to70)	8	427	427	0	Deg	70	-30	P	-0.37	64.43
HIU	Temp Cal 2nd 7 (-30to70)	8	428	428	0	Deg	70	-30	P	-0.37	64.43
HIU	Temp Cal (-100to100)	8	429	429	0	Deg	100	-100	P	0.912	-109.12
HIU	HIU Pos. 5 Vdc	8	430	430	0	Volt	5	0	P	0.0195	0
HIU	HIU Pos. 12 Vdc	8	431	431	0	Volt	12	0	P	0.06735	0
HIU	HIU Neg. 12 Vdc	8	432	432	0	Volt	-12	0	P	-0.235	0
HIU	HIU Pos. 28 Vdc	8	433	433	0	Volt	5	0	P	0.156	0
HIU	Avionics Shelf Temp #1	8	434	434	0	Deg C	70	-30	P	-0.37	64.43
HIU	Avionics Shelf Temp #2	8	435	435	0	Deg C	70	-30	P	-0.37	64.43
HIU	Avionics Shelf Temp #3	8	436	436	0	Deg C	70	-30	P	-0.37	64.43
HIU	Aft Shelf Temp	8	437	437	0	Deg C	70	-30	P	-0.37	64.43
HIU	Bus Panel #1	8	438	438	0	Deg C	70	-30	P	-0.37	64.43
HIU	Aft GPS Antenna Bracket	8	439	439	0	Deg C	70	-30	P	-0.37	64.43
HIU	Bus Panel #3	8	440	440	0	Deg C	70	-30	P	-0.37	64.43
HIU	Bus Panel #4	8	441	441	0	Deg C	70	-30	P	-0.37	64.43
HIU	Avionics Shelf Temp #4	8	442	442	0	Deg C	70	-30	P	-0.37	64.43
HIU	Bus Panel #6	8	443	443	0	Deg C	70	-30	P	-0.37	64.43
HIU	Dosimeter Box Temp	8	444	444	0	Deg C	70	-30	P	-0.37	64.43
HIU	Batt 1 Radiator	8	445	445	0	Deg C	70	-30	P	-0.37	64.43
HIU	Batt 2 Radiator	8	446	446	0	Deg C	70	-30	P	-0.37	64.43
HIU	PASP-Plus Box Temp	8	447	447	0	Deg C	70	-30	P	-0.37	64.43
HIU	PASP-Plus Shelf Temp	8	448	448	0	Deg C	100	-100	P	0.912	-109.12
HIU	PASP-Plus Panel Temp	8	449	449	0	Deg C	100	-100	P	0.912	-109.12
HIU	E Field Shelf Sensor Temp	8	450	450	0	Deg C	100	-100	P	0.912	-109.12
HIU	Spare 451	8	451	451	0	Deg C	100	-100	P	0.912	-109.12
HIU	Spare 452	8	452	452	0	Deg C	100	-100	P	0.912	-109.12
HIU	E Field Panel Sensor Temp	8	453	453	0	Deg C	100	-100	P	0.912	-109.12
HIU	Plus Y PPE Panel	8	454	454	0	Deg C	100	-100	P	0.912	-109.12
HIU	Depoly All Command Recieved	1	455	455	7	Y/N				0=Not Rcv	1=Recieved
HIU	Pwr To Exp Panel Hinge	1	455	455	6	Y/N			B	0=Off	1=On
HIU	Pwr to Exp Panel Lock	1	455	455	5	Y/N			B	0=Off	1=On
HIU	Pwr to S/A #3 Lock	1	455	455	4	Y/N			B	0=Off	1=On
HIU	Pwr to S/A #2 Lock	1	455	455	3	Y/N			B	0=Off	1=On
HIU	Pwr to S/A #1Lock	1	455	455	2	Y/N			B	0=Off	1=On
HIU	Hinge, Experiment Panel B	1	455	455	1	Y/N			B	0=Depld	1=Stow
HIU	Hinge, Experiment Panel A	1	455	455	0	Y/N			B	0=Depld	1=Stow
HIU	Hinge, Solar Array #3	1	456	456	7	Y/N			B	0=Depld	1=Stow
HIU	Hinge, Solar Array # 2	1	456	456	6	Y/N			B	0=Depld	1=Stow
HIU	Hinge, Solar Array #1	1	456	456	5	Y/N			B	0=Depld	1=Stow
HIU	Launch Lock Exp Panel B	1	456	456	4	Y/N			B	0=Rlesd	1=Locked
HIU	Launch Lock Exp Panel A	1	456	456	3	Y/N			B	0=Rlesd	1=Locked
HIU	Launch Lock Solar Array 3	1	456	456	2	Y/N			B	0=Rlesd	1=Locked
HIU	Launch Lock Solar Array 2	1	456	456	1	Y/N			B	0=Rlesd	1=Locked

H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
HIU	Launch Lock Solar Array 1	1	456	456	0	Y/N			B	0=Rlesd	1=Locked
HIU	Exp Panel LL Seq Complete	1	457	457	7	Y/N			B	0=NotCmp	1=Complete
HIU	Solar Array #3 LL Seq Complete	1	457	457	6	Y/N			B	0=NotCmp	1=Complete
HIU	Solar Array # 2 LL Seq Complete	1	457	457	5	Y/N			B	0=NotCmp	1=Complete
HIU	Solar Array #1 LL Seq Complete	1	457	457	4	Y/N			B	0=NotCmp	1=Complete
HIU	Init Cond Exp Panel Hinge	1	457	457	3	Y/N			B	0=Nom	1=Wrong
HIU	Init Cond Exp Panel Lock	1	457	457	2	Y/N			B	0=Nom	1=Wrong
HIU	Init Cond S/A #3 Lock	1	457	457	1	Y/N			B	0=Nom	1=Wrong
HIU	Init Cond S/A #2 Lock	1	457	457	0	Y/N			B	0=Nom	1=Wrong
HIU	Init Cond S/A #1 Lock	1	458	458	7	Y/N			B	0=Nom	1=Wrong
HIU	Deploy Timer On	1	458	458	6	Y/N			B	0=Off	1=On
HIU	Exp Pnl Hinge In Progress	1	458	458	5	Y/N			B	0=Idle	1=Active
HIU	Exp Pnl Lock In Progress	1	458	458	4	Y/N			B	0=Idle	1=Active
HIU	S/A #3 In Progress	1	458	458	3	Y/N			B	0=Idle	1=Active
HIU	S/A #2 In Progress	1	458	458	2	Y/N			B	0=Idle	1=Active
HIU	S/A #1 In Progress	1	458	458	1	Y/N			B	0=Idle	1=Active
HIU	Sequence In Progress	1	458	458	0	Y/N			B	0=Idle	1=Active
HIU	Heater #1 Auto/Override	1	459	459	7	Y/N			B	0=Auto	1=Override
HIU	Heater #1 Cmd On/Off	1	459	459	6	Y/N			B	0=Off	1=On
HIU	Htr #1 Sensor 2 Enable	1	459	459	5	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #1 Sensor 1 Enable	1	459	459	4	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #1 Sensor 0 Enable	1	459	459	3	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #1 Sensor 2 Valid	1	459	459	2	Y/N			B	0=Error	1=Valid
HIU	Htr #1 Sensor 1 Valid	1	459	459	1	Y/N			B	0=Error	1=Valid
HIU	Htr #1 Sensor 0 Valid	1	459	459	0	Y/N			B	0=Error	1=Vaílid
HIU	Heater #2 Auto/Override	1	460	460	7	Y/N			B	0=Auto	1=Override
HIU	Heater #2 Cmd On/Off	1	460	460	6	Y/N			B	0=Off	1=On
HIU	Htr #2 Sensor 2 Enable	1	460	460	5	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #2 Sensor 1 Enable	1	460	460	4	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #2 Sensor 0 Enable	1	460	460	3	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #2 Sensor 2 Valid	1	460	460	2	Y/N			B	0=Error	1=Valid
HIU	Htr #2 Sensor 1 Valid	1	460	460	1	Y/N			B	0=Error	1=Valid
HIU	Htr #2 Sensor 0 Valid	1	460	460	0	Y/N			B	0=Error	1=Vaílid
HIU	Heater #3 Auto/Override	1	461	461	7	Y/N			B	0=Auto	1=Override
HIU	Heater #3 Cmd On/Off	1	461	461	6	Y/N			B	0=Off	1=On
HIU	Htr #3 Sensor 2 Enable	1	461	461	5	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #3 Sensor 1 Enable	1	461	461	4	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #3 Sensor 0 Enable	1	461	461	3	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #3 Sensor 2 Valid	1	461	461	2	Y/N			B	0=Error	1=Valid
HIU	Htr #3 Sensor 1 Valid	1	461	461	1	Y/N			B	0=Error	1=Valid
HIU	Htr #3 Sensor 0 Valid	1	461	461	0	Y/N			B	0=Error	1=Vaílid
HIU	Heater #4 Auto/Override	1	462	462	7	Y/N			B	0=Auto	1=Override
HIU	Heater #4 Cmd On/Off	1	462	462	6	Y/N			B	0=Off	1=On
HIU	Htr #4 Sensor 2 Enable	1	462	462	5	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #4 Sensor 1 Enable	1	462	462	4	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #4 Sensor 0 Enable	1	462	462	3	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #4 Sensor 2 Valid	1	462	462	2	Y/N			B	0=Error	1=Valid
HIU	Htr #4 Sensor 1 Valid	1	462	462	1	Y/N			B	0=Error	1=Valid
HIU	Htr #4 Sensor 0 Valid	1	462	462	0	Y/N			B	0=Error	1=Vaílid
HIU	Heater #5 Auto/Override	1	463	463	7	Y/N			B	0=Auto	1=Override
HIU	Heater #5 Cmd On/Off	1	463	463	6	Y/N			B	0=Off	1=On
HIU	Htr #5 Sensor 2 Enable	1	463	463	5	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #5 Sensor 1 Enable	1	463	463	4	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #5 Sensor 0 Enable	1	463	463	3	Y/N			B	0=Disbl	1=Enbl
HIU	Htr #5 Sensor 2 Valid	1	463	463	2	Y/N			B	0=Error	1=Valid
HIU	Htr #5 Sensor 1 Valid	1	463	463	1	Y/N			B	0=Error	1=Valid
HIU	Htr #5 Sensor 0 Valid	1	463	463	0	Y/N			B	0=Error	1=Vaílid
HIU	Spare 464	3	464	464	5						
HIU	Heater #5 Relay On/Off	1	464	464	4	Y/N			B	0=Off	1=On
HIU	Heater #4 Relay On/Off	1	464	464	3	Y/N			B	0=Off	1=On
HIU	Heater #3 Relay On/Off	1	464	464	2	Y/N			B	0=Off	1=On
HIU	Heater #2 Relay On/Off	1	464	464	1	Y/N			B	0=Off	1=On

H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
HIU	Heater #1 Relay On/Off	1	464	464	0	Y/N			B	0=Off	1=On
TTC	Receiver Temp	8	465	465	0	Deg C		-30	P	-0.4198	60.24
TTC	Receiver Sig. Strength	8	466	466	0	db/m	70	-110	P	1.556	-400.9
TTC	Third Stage Sep Sense A	1	467	467	7	position			B	0=Sep	1=Attach
TTC	Third Stage Sep Sense B	1	467	467	6	position			B	0=Sep	1=Attach
TTC	Transmit Antenna Sel.	1	467	467	5	position			B	0=ant 1	1=ant 2
TTC	Spare 467	3	467	467	2						
TTC	Coherent Mode	1	467	467	1	Y/N			B	0=NonCoh	1=Coherent
TTC	Command Signal Pres.	1	467	467	0	Y/N			B	0=NoSig	1=SigPr
TTC	KIV Standby	1	468	468	7	Y/N			B	0=Receiv	1=Stand
TTC	KIV Index Changed	1	468	468	6	Y/N			B	0=NoCh	1=Change
TTC	KIV Current Key Index	6	468	468	0	Int			D	decimal	
TTC	Transmitter Temp	8	469	469	0	Deg C		-30	P	-0.4198	60.24
TTC	RF Transmitted Power	8	470	470	0	dBm	70	0	P	0.108	24.96
TTC	Spare 471	1	471	471	7						
TTC	KGV Encryption Key	3	471	471	4	Int			D	decimal	
TTC	KGV RANTA	1	471	471	3	Y/N			B	0=Nom	1=Alarm
TTC	KGV Fault	1	471	471	2	Y/N			B	0=Nom	1=Fault
TTC	KGV Busy	1	471	471	1	Y/N			B	0=Idle	1=Busy
TTC	KGV Ready	1	471	471	0	Y/N			B	0=NtReady	1=Ready
HIU	HIU Stack Pointer	16	472	473	0	Hex			H	Hex	
GPS Telemetry Points											
GPS	GPS Clock Offset	4	474	474	4	Int			P	100	0
GPS	GPS App Error Count	3	474	474	1	Int			D	decimal	
GPS	GPS Packet Status	1	474	474	0	Y/N			B	0=Valid	1=Miss
GPS	X Position (83)	32	475	478	0	Meter			H	IEEE Single	
GPS	Y Position (83)	32	479	482	0	Meter			H	IEEE Single	
GPS	Z Position (83)	32	483	486	0	Meter			H	IEEE Single	
GPS	Time Of Position Fix (83)	32	487	490	0	Sec			H	IEEE Single	
GPS	X Velocity (43)	32	491	494	0	M/s			H	IEEE Single	
GPS	Y Velocity (43)	32	495	498	0	M/s			H	IEEE Single	
GPS	Z Velocity (43)	32	499	502	0	M/s			H	IEEE Single	
GPS	Bias Rate (43)	32	503	506	0	M/s			H	IEEE Single	
GPS	Time Of Velocity Fix (43)	32	507	510	0	Sec			H	IEEE Single	
GPS	Health Code (46)	8	511	511	0				H	Table	
GPS	Error Code (46)	8	512	512	0				H	Table	
SCM	GPS Sat. Selection (44h)	168	513	533	0				H	Table	
SCM	GPS Machine C/S (4Bh)	24	534	536	0				H	Table	
SCM	GPS Raw Data Sat #1(E4)	256	537	568	0				H	Table	
SCM	GPS Raw Data Sat #2(E4)	256	569	600	0				H	Table	
SCM	GPS Raw Data Sat #3(E4)	256	601	632	0				H	Table	
SCM	GPS Raw Data Sat #4(E4)	256	633	664	0				H	Table	
SCM	Clock Bias (83)	32	665	668	0				H	IEEE Single	
FERRO Telemetry Points											
PSM	Spare 669	6	669	669	2						
PSM	FERRO Late Packet Flag	1	669	669	1	Y/N			B	0=Valid	1=Miss
PSM	FERRO SOH Packet Status	1	669	669	0	Y/N			B	0=Valid	1=Miss
PSM	FERRO Real-Time Data	312	670	708	0	Hex			H		
Dosimeter Telemetry Points											

H/W System	Telemetry Point	Bit Len	Byte Range Start	End	Bit Offset	IEEE Units	Engineering HI	LO	Type	Conversion Slope	Intercept
PSM	Spare 709	6	709	709	2						
PSM	Dosimeter Late Packet Flag	1	709	709	1	Y/N			B	0=Valid	1=Miss
PSM	Dosimeter Packet Status	1	709	709	0	Y/N			B	0=Valid	1=Miss
PSM	Dosimeter Real-Time Data A	8	710	710	0	Hex			H		
PSM	Dosimeter Real-Time Data B	8	711	711	0	Hex			H		
PSM	Dosimeter Real-Time Data C	32	712	715	0	Hex			H		
PSM	Dosimeter Real-Time Data D	8	716	716	0	Hex			H		
PSM	Dosimeter Real-Time Data E	48	717	722	0	Hex			H		
PSM	Dosimeter Real-Time Data F	8	723	723	0	Hex			H		
PSM	Dosimeter Real-Time Data G	64	724	731	0	Hex			H		
PSM	Dosimeter Real-Time Data H	16	732	733	0	Hex			H		
PSM	Dosimeter Real-Time Data I	80	734	743	0	Hex			H		
PASP-Plus Telemetry Points											
PSM	PASP Late Packet Flag	1	744	744	7	Y/N			B	0=Valid	1=Miss
PSM	PASP Packet Status	7	744	744	0	Y/N			B	0=Valid	1=Miss
PSM	PASP Real-Time Data A	40	745	749	0	Hex			H		
PSM	PASP Real-Time Data B	2008	750	1000	0	Hex			H		
Total Minor Frame 0		8000									
	Spare Pegasus Real Time	32									
	Spare Pegasus Historical	48									
	Total Pegasus Frame										
Header - Minor Frame 1											
	Frame Synch	32	1	4	0						
	Frame ID	8	5	5	0						
	Format ID	8	6	6	0						
CRUX Telemetry Points											
PSM	Spare 7	6	7	7	2	Dig			D		
PSM	CRUX Late Packet Flag	1	7	7	1	Dig			D	0=Valid	1=Miss
PSM	CRUX Packet Status	1	7	7	0	Dig			D	0=Valid	1=Miss
PSM	CRUX Real-Time Data	6312	8	796	0	Dig			D		
Spare Telemetry Points											
	Spare 797	200	797	821	0						
CSM Telemetry Points											
SCM	Spare 822	7	822	822	1				D		
SCM	CSM Packet Status	1	822	822	0				D	0=Valid	1=Miss
SCM	Spare 823	5	823	823	3				D		
PSM	CSM Update/Execute Flag	1	823	823	2	Dig			B	0=Update	1=Execute
PSM	CSM Download ADDR 'N'	10	823	824	0	Dig			D	Decimal	
PSM	CSM Time-Tag Cmd 'N'	88	825	835	0	Dig			D	Table	
PSM	CSM Time-Tag Cmd 'N+1'	88	836	846	0	Dig			D	Table	
PSM	CSM Time-Tag Cmd 'N+2'	88	847	857	0	Dig			D	Table	
PSM	CSM Time-Tag Cmd 'N+3'	88	858	868	0	Dig			D	Table	
PSM	CSM Time-Tag Cmd 'N+4'	88	869	879	0	Dig			D	Table	
PSM	CSM Time-Tag Cmd 'N+5'	88	880	890	0	Dig			D	Table	
PSM	CSM Time-Tag Cmd 'N+6'	88	891	901	0	Dig			D	Table	
PSM	CSM Time-Tag Cmd 'N+7'	88	902	912	0	Dig			D	Table	
PSM	CSM Macro Cmd 'N'	88	913	923	0	Dig			D	Table	
PSM	CSM Macro Cmd 'N+1'	88	924	934	0	Dig			D	Table	
PSM	CSM Macro Cmd 'N+2'	88	935	945	0	Dig			D	Table	
PSM	CSM Macro Cmd 'N+3'	88	946	956	0	Dig			D	Table	
PSM	CSM Macro Cmd 'N+4'	88	957	967	0	Dig			D	Table	
PSM	CSM Macro Cmd 'N+5'	88	968	978	0	Dig			D	Table	
PSM	CSM Macro Cmd 'N+6'	88	979	989	0	Dig			D	Table	
PSM	CSM Macro Cmd 'N+7'	88	990	1000	0	Dig			D	Table	

H/W System	Telemetry Point	Bit Len	Byte Range		Bit Offset	IEEE Units	Engineering		Type	Conversion	
			Start	End			HI	LO		Slope	Intercept
Total Minor Frame 1		**8000**									